Master's Thesis

Performance of public and private residential real estate portfolios from an individual investor's perspective

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By

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Abstract

This paper studies the profitability of private and public real estate from a retail investor standpoint. The aim is to assess which of the two alternative is best suited for an investor with limited time and money to invest. To do so, portfolios of apartments throughout Canada with value ranging from $1,000,000 to $1,410,000 are constructed and compared to a portfolio of Canadian residential REITs. These portfolios are examined on 4 periods: the pre-crisis (2004-2006), the crisis (2007-2008), the post-crisis (2009-2019) and the full periods (2004-2019). Additionally, the portfolios are studied during the current crisis due to the COVID-19. The results are clear, in non-crisis periods, the REITs portfolio significantly outperforms every apartment portfolio. However, in times of high uncertainty and economic slow-down, the apartment portfolios' resilience allows for higher profitability and lower variance than the REITs portfolio. Over the 16 years period (2004-2019), the residential REITs portfolio is the most profitable investment, attaining 8.47 million dollars in value compared to the 3.88 million of the best performing apartment portfolio.

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1. **Introduction**

In recent years, an increasing number of securities were introduced to the stock market. Among others, infrastructure and real assets securities emerged and became fully fledged components of the stock market. While infrastructure securities are still scarce in the Canadian stock market, real estate securities have grown exponentially in the past decade. The most popular real estate securities are equity Real Estate Investments Trusts (REITs), which are pools of real estate investments made accessible to every investor. Thus, everyone, from retail investors to institutional investors can invest in real estate via the stock market. The investor can own real estate without going through the troublesome process of investing in properties. This simplicity bundled with the ability to come in and out of the investment with ease is a recipe for success. Indeed, the REITs sector grew 600% since 1998 in Canada. From the half-dozen REITs, in the early 2000, the stock market now has more than 60 REITs currently traded. Additionally, new classes of equity REITs emerged, and the sector now counts seven major classes; retail, residential, office, self-storage, senior care, industrial and diversified. Moreover, the performance of this sector has been impressive since the get-go. In the US, the Nareit equity REITs index consistently outperforms the S&P500 index, and in Canada, the TSX Capped REITs index's returns surpassed the S&P/TSX for the most part of the last two decades. But still, REITs account for only a fraction of the stock market and of the real estate market. It seems that investors are not fully educated on the sector or that they have access to more profitable investments.

Indeed, it is legitimate to ask ourselves if the underlying assets of REITs, private real estate, is more profitable than REITs. Similarly to some portfolio managers, REITs could have important management fees that decrease the profitability of underlying investments. Or on the contrary, the management of such entities is such that they significantly outperform investment in private real estate. Individual investors often lack the resources of bigger entities and face steep operational costs. While institutional investors such as pension funds, banks and insurance companies have the resources to invest heavily in real estate and benefit from scale economies, retail investors do not have the same opportunities. Additionally, the literature on institutional investments in REITs and private real estate is already significant. Contrarily, rare are the articles studying the subject for retail investors. In an effort to expand the literature for retail investors, this paper is studying both alternative, REITs and private real estate, from an individual investor's perspective. This paper is a forerunner for researches on retail investors.

How does public real estate (REITs) compared to private real estate from an individual investor's perspective? To answer this question, residential real estate, the most popular among retail investors, is studied in depth, in both the securitized and unsecuritized market. Evidently, retail investors have limited resources compared to institutions. And this is precisely the idea, to understand how one can invest a million dollars in the most profitable manner. This research does not focus on building an efficient portfolio, but rather to study asset classes that can be added to a portfolio. To do so, portfolios of residential real estate assets, more specifically apartments, and of REITs are constructed on a 16-year period. On the real asset's side, the apartments are spread across four cities in Canada to capture the heterogeneity of the market and to be able to construct geographically diversified portfolios. The construction of the portfolio starts with a maximization of the number of apartments purchased with a million dollars. Then, it is mandatory to estimate the appreciation and the revenue steaming from the assets. To do so, the extensive data available on the Canadian real estate market allows for monthly monitoring of the evolution of the portfolio. Additionally, the question of risk is largely examined in every apartment portfolio. On the REITs side, the focus was to create a portfolio that could be done by an individual investor. Luckily, the limited number of residential REITs allows for a straightforward portfolio construction. In the span of 16 years, from 2004 to 2019, only 13 REITs existed. Thus, the REITs portfolio is a market capitalization-weighted index of the residential REITs sector. But this small number of REITs is a blessing and a curse; it greatly simplifies the portfolio construction for the investor, but it also limits the diversification within the asset class. However, REITs are already diversified securities in the sense that each REIT contains hundreds of different units, often geographically diversified. Finally, the 16 years are split into 3 periods, the pre-correction (2004-2006), the correction (2007-2008) and the post-correction (2009-2019) periods. The decomposition in periods allows for an in-depth study of the effect of a correction on the risk-return profile of both investment vehicles. The correction is the subprime crisis that lead to a recession between 2007 and 2009. The choice of the correction period between January 2007 to December 2008 is motivated by the performance of the Canadian real estate market between 2007 and 2009. The impact of the crisis is evident in 2007 and 2008 but 2009 displayed strong returns in the residential real estate space. For instance, the residential REITs portfolio studied in this paper had an annual return of 29,63% in 2009, compared to the -28,36% return in 2008 (Table 6). Additionally, real estate American and Canadian ETFs also showed evidence of significant returns in 2009. The iShares SPTSX Capped REIT Index (Canadian) and Vanguard Real Estate Index Fund (American) had respectively annual returns of 48,79% and 19,83% which are far from the catastrophic returns

of 2007 and 2008. Thus, it is hard to argue that 2009 was impacted by the crisis the same way 2007 and 2008 were. Hence, in this paper the choice of correction period is based on the performance of the sector.

This research aims to compare two asset classes from the point of view of an investor with limited resources (time and money) compared to institutional investors. Additionally, the paper allows investors with limited knowledge on REITs to discover the sector's characteristics and profitability. Overall, a portrait of the risks and returns for both alternative is built. The aim of this paper is to determine which vehicle is best suited for individual investors. It is clear that REITs and private real estate have fundamentally different dynamics. And while REITs are partially driven by their underlying assets (i.e. private real estate), the main cause of price movement is not related to real estate. It is not rare to observe, for REITs, difference of valuation of millions of dollars in a short time spends. For example, the Boardwalk REIT gained 19,56% in value between November 21, 2008, and November 28, 2008, then lost 14,52% in the following week (the 28th of November to the 5th of December 2008). The market capitalization of the Boardwalk REIT was around 1.9 billion dollars in November 2008. Meaning that in the span of two weeks, the company gained then lost hundreds of millions of dollars.Thus, if the value of the company had been only based on the underlying assets (residential real estate assets), the assets would have gained more than a quarter of a billion dollars in value between November 21 and November 28, 2008.Evidently, such variation in the private real estate market is improbable. Hence, it is clear that REITs are not marked-to-market and that their valuation is driven by many factors and the real estate market is only one of them. One could study the extent to which private real estate impacts REITs valuation and returns, but this paper will not. In general the real estate market is different from other financial markets and many principles cannot be applied. For instance, the well-known law of price is not applicable in our case. Indeed, this law requires a frictionless market and the ability to use arbitrage strategy. However, the private real estate market faces steep transactional costs, which violates the frictionless assumption, and arbitrage is very limited, as short-selling is nearly impossible. Moreover, REITs own portfolios of hundreds of properties which are indivisible making the apple-to-apple comparison impossible. In this research, a comparison of geographically diversified portfolios and REITs is made, and the end goal is not to find a possible arbitrage theory or to demonstrate that the law of one price is applicable or not, but rather to assess the profitability of both investment strategy from an individual investor standpoint. However, in an effort to have a fair comparison, one of the fundamental differences between REITs and the private real estate portfolios constructed,

leverage, is accounted for.Indeed, the leverage effect can be substantial, and controlling its effect is critical. The residential REIT space have an average debt to book value of 41%. So, to reproduce this leverage, the individual investor is assumed to undertake a loan of $410,000 (41% of 1,000,000). Thus, this variable is accounted for, and diversified portfolios of apartments are constructed with the same debt to book value ratios as residential REITs.

And the results are clear, the residential REITs sector outperforms private real estate in non-correction periods. In the pre and post-correction periods both the REITs portfolio and the apartment portfolios experienced significant positive returns, but the capital gain is substantially higher with the REITs portfolio. In the pre-correction period, the REITs portfolio had a compounded annual growth rate (CAGR) of 28,09% against 15,15% for the best performing apartment portfolios (Vancouver). Similarly, during the post-correction period the REITs portfolio had a CAGR of 16,91% compared to 10,28% of the apartment portfolio in Toronto, which displayed the highest return on this period. However, the results are diametrically opposed for the correction period. While the apartment portfolios managed to generate positive returns, the REITs portfolio crashed with the stock market, registering a drop in value of 24% in one year. Evidently, the resilience of the REITs portfolio in tumultuous times is considerably worse than the apartment portfolios. The risk profile of real assets (i.e. apartment) is undoubtedly more attractive in economic downturn than the one for securitized real estate. When the full period (2004-2019) is considered, the performance of the REITs portfolio is far superior to the apartment portfolios. And the debt structure of REITs cannot explain their excess return. The levered portfolios created to reproduce the leverage effect of REITs displayed higher returns than unlevered portfolios but could not compete with the profitability of REITs.

The analysis provides proof that REITs are more profitable than private real estate for retail investors with limited resources. In addition, securitized real estate allows for smaller investment and thus is accessible to more investors. In contrary, private real estate requires a substantial initial investment to buy properties without leverage. Overall, it seems that REITs are more suitable for retail investors that wish to enter the real estate market. But the resilience of unsecuritized real estate might motivate risk averse retail investors to choose real assets.

This paper offers a comprehensive review of two investments alternatives. Articles on REITs and private real estate from an institutional investor's perspective are popular (Ciochetti, Craft and Shilling (2002), Bond, Hwang and Richards (2006), Benveniste, Capozza and Seguin (2001), Clayton and McKinoon (2002), Nelling and Gyourko (1998)) and Ang (2012)). The

novelty arises from the target of this research: retail investors. And because this research will be useful to individual investors, the analysis conducted in this paper can be understood by investors with little to no knowledge on real estate and the stock market. In addition, the data used in this research is used to test findings of articles. Mainly, the variance formula of Lin, Liu and Vandell (2009), adjusted for liquidity and price risks. But also the findings of Ang (2012) who found that REITs are closer to stocks than private real estate. Ngai and Tenreyro (2013) and Chmiel and Rodriguez (2019) who studied the seasonality of both real estate and REITs returns. And finally, Xiong and Idzorek (2011) who examined the effect of distributions on asset allocation. The data and the results at hand allowed to confirm or challenge all these results.

The remainder of this paper is structured as follows: section 2 reviews the existing literature in real estate and REITs. Section 3 describes the data used to construct the apartment and the REITs portfolios. In section 4, an in-depth analysis of the methodology is conducted. Section 5 presents and interprets the results. Section 7 links the findings with existing literature and finally section 8 concludes.

2. <u>Literature review</u>

2.1. Real estate as an investment vehicle

Real assets recently gained their popularity, with an increasing number of institutional and individual investors searching for alternative investment vehicles. While infrastructure is a fairly recent investment vehicle, real estate is an established instrument that has been extensively studied. Through the years, researchers tried to understand the ins and outs of this particular market, one of which seems to be inefficiency.

2.1.1. Real estate inefficiency

Clayton (1998) found evidence of the real estate market inefficiency by studying condominiums in Vancouver. His research led to discover that future excess returns are partly predictable, hinting that the weak form efficiency hypothesis does not apply to this market. He discovered that prices are based on irrational expectations, with a significant difference between market fundamentals and observed prices. Unsurprisingly, several articles found that the seller's characteristics impact the listed price and ultimately the selling price. For instance, it has been proven that the level of equity of a seller has a direct impact on the asked price (Genesove and Mayer (1997)). The authors studied the effect of what they called the "loan to value ratio" (LTV), which is informative on the financial situation of the seller, on the selling prices. Their results are significant; an individual with 100% LTV will list his unit 4% higher than an individual with 80% LTV. Other articles found evidence that loss aversion, prospect theory (Genesove and Mayer (2001)) and even sunk costs (Ratnadiwakara and Yerramilli (2017)) impact the owner's valuation of his unit.

Another indicator of the market's inefficiency is its seasonality. The article "Hot and Cold seasons in the housing market" (Ngai and Tenreyro (2013)) studied the UK market and determined that the fourth and first quarter are associated with a decrease in activities and lower prices. While these findings are specific to the housing market, they illustrate how inefficient the real estate market can be.

Vasco et al. examined how the size of the purchased assets impact the returns. They managed to demonstrate that microassets (acquired at a price between 1 and 10 million) significantly outperform macroassets (price greater than 10 million):

"The results obtained from the analysis showed, with a 90% confidence level, that microassets yielded an 8.76% higher internal rate of return internal rate of return (IRR) than macroassets. Similarly, the analysis found, with a 99% confidence level, that the change in value of microassets is 15.97% higher than that of macroassets.". They attributed this to 3 main factors: the small firm effect, the oversupply of macroassets and the inefficiency of the market. The small firm effect has been widely studied and asserts that small firm outperform large firms. In addition, larger investors seem to experience more pressure to purchase assets, thus impacting their price discipline. On the other hand, smaller investors are vigilant and wait for undervalued properties to invest. Finally, the size of the asset is somewhat correlated with the level of information. Smaller assets do not benefit from the same precision in information as large assets do, and this is reflected in the price. Hence, proving that the level of efficiency can vary depending on the type and size of the asset.

Thus, the price of a property can depend, amongst other things, on its size, his seller and the period of the year. It seems that the Law of one price can hardly be applied in the real estate market. Because the selling price is so dependent on variables that are not in-line with efficient markets, one cannot assert that two identical real estate assets will have the same price. Additionally, the law of one price relies on two fundamental principles: frictionless market and arbitrage. Both of these principles are not applicable to private real estate. Indeed, transaction costs are enormous in private real estate, violating the principles of frictionless market. And, because of the difficulty to short sell, arbitrage opportunities cannot be seized. This has been, and still is, one of the reasons for real estate market inefficiency, when price are irrational, the standard adjusting mechanism (arbitrage) is not applicable.

2.1.2. Real estate liquidity

While all these factors are non-negligible, the biggest concern in real estate is its illiquidity. Many researchers studied this matter and their result converges to one conclusion: the risk associated with real estate is often underestimated and the popular financial models cannot be directly applied to this asset class. Lin (2004) conducted an in-depth review of the liquidity bias in real estate, accounting for the marketing period and biases in pricing. The author found that two of the most important biases in the real estate literature are the appraisal and the sample selection bias. The appraisal bias was the first solution found to the risk premium puzzle (i.e. the significantly higher risk-return profile of real estate compared to other assets). This bias is attributed to indexes' construction methods: instead of using transactions, the indexes are built

with appraisal values. This method has a major drawback: it underestimates the risk associated with real estate. Appraisal based indexes tend to smooth the changes in prices overtime, reducing the variance of the asset class. This, in turn, results in a higher risk-return ratio. But Geltner and Goetzman (2000) constructed a non-appraisal-based index and found that the risk-return ratio of real estate was still significantly higher, proving that appraisal bias cannot explain the risk premium puzzle.

The sample selection bias states that some type of assets, even if they do not represent the majority of the share of the market, are sold more frequently. This implies that the asset will be overrepresented in the sold properties sample.

These biases are relevant in the study of real estate but are second to the illiquidity problem. Lin found that our current valuation technic does not account for the marketing period and thus underestimate the risk but also overestimate the returns. He illustrates this problem with the returns of different asset classes between 1978 and 1998 : "In terms of risk-adjusted return, NCREIF's (National Council of Real Estate Investment Fiduciaries) Sharpe ratio (1.47) is more than six times that of bonds and at least three times that of both the large cap stocks (0.41) and the small cap stocks (0.35)". The author also provided proof that real estate returns and risk are impacted by the holding period, proving that real estate returns are not i.i.d. According to his findings, a US investor holding a residential real estate investment for one year is exposed to a risk 4 times higher than the current estimations. As the holding period increases, the amortization of the marketing period risk results in a lower risk, approximately 1.5 times higher than the current estimations for a 10-year holding period.

In similar fashion, Cheng, Lin and Liu studied the effect of illiquidity on portfolio risk. The fact that returns exhibit a non iid distribution makes every classical finance theory irrelevant to real estate. After observing the variance of the returns, the authors determined that a linearly increasing standard deviation is the closest approximation that they could find. They also developed a variance formula to account for price and illiquidity risk, with which they establish that the effect of liquidity risk is mitigated by a longer holding period but this, in turn, is offset by the rising price risk. Finally, they suggested that, considering these two-clashing effects, an optimal holding period might exist for real estate investments.

In another article Cheng, Lin and Liu (2008) attributed the risk premium puzzle to inappropriate risk measurement and rejected the role of appraisal bias in the puzzle.

Over the years, researchers proved that real estate does not outperform every other asset classes as some might have thought, but this alternative investment is nonetheless very attractive.

2.1.3. Optimal allocation of real estate in a diversified portfolio

Bond, Hwang and Richards (2006) computed the optimal allocation of real estate in a portfolio accounting for illiquidity risk. Indeed, before the liquidity adjusted risk, the discrepancy between optimal and observed investment in real estate by institution was significant. Here, the authors decided to study this with the risk accounted for. Prior studies (Hudson-Wilson et al. (2003)) suggested that the optimal investment in real estate was between 15 to 20 percent. This number is significantly different from the 3 to 6 percent allocation in this asset class observed in the UK. Because real estate has been proven to be holding-period dependent, the optimization is strongly linked to this period, and thus no one-fit-all result can be found. The researchers constructed different portfolios, with different horizons and different risks, in the mean-variance framework. Their findings suggest that accounting for the liquidity risk is not sufficient to explain the difference between optimal and observed allocation in real estate. They proved that real estate exhibits lower risk (after liquidity adjustment) and higher return than bonds for a 5 years horizon, however, for a shorter horizon of 1 year, bonds are less risky but still less profitable. These results are consistent with the holding-period dependency of real estate and the unused potential of the asset class.

Another potential explanation for the historical underinvestment of institution in this asset class could be its skewness and fat tails distributions (Xiong and Idzorek (2011)). Factoring the third moment in the optimization yields different results. Indeed, they optimized different assets allocation with a M-CVaR model and found that negative skewness and fat tails impact the allocations. They also found that US REITs display negative skewness and higher kurtosis, which could be a possible explanation for the underinvestment in real estate.

2.1.4. Real estate and inflation

One misconception that persisted over the year concerns the ability of real estate to hedge against inflation. For years, investors thought that the asset class was the most efficient to reduce their exposure to be expected and unexpected inflation. Since, it has been proven to be wrong, Stevenson and Murray (1999) studied Irish real estate and concluded that real estate does not fully hedge against inflation. Ang (2012) found that real estate is at best a partial hedge against inflation on the long run. He also concluded that REITs are far worst to hedge inflation than real estate.

2.2. Real Estate Investment Trusts

A popular question in the real estate industry has yet to be fully answered: What properties do REITs and real estate share? To some extent, the underlying asset (real estate) has some explaining power but ultimately, REITs seem to be closer to equity than real estate (Ang (2012)). To answer this question, a thorough study is required, and this paper aims is not to do that. However, it is important to appreciate the characteristics of REITs before creating the portfolios. First, while every REIT own hundreds or thousands of individual properties, these properties are consolidated into one indivisible pool. The overall return of the REIT is then partly attributable to the performance of each property in the portfolio. However, a large part of the return is not related to the performance of the properties, making it difficult to discern how much each property contributed to the return. In other words, REITs are not marked-to-market, as their values fluctuate more than their underlying assets (private real estate). And the apple-to-apple comparison is not feasible because of the indivisible nature of REITs' portfolios. Thus, the readers should keep in mind that this paper will assess the profitability of both alternatives (private and public real estate investment) but will not conduct an apple-to-apple comparison or a proof that there exist arbitrage opportunities between REITs and private real estate.

2.2.1. REITs liquidity

The major difference is liquidity, while real estate faces some strong illiquidity constraints, REITs benefit from similar levels liquidity as stocks do. In that sense, indirect real estate (REITs) is a game changer, allowing investors to enter and exit the real estate market at their own term. Unsurprisingly, Ciochetti, Craft and Shilling (2002) found evidence that liquidity constrained investment funds choose REITs over private real estate. In addition, recruiting a team to invest and manage private real estate is an expense that many investment funds are not willing to have.

In Canada, REITs grew strongly in the mid 2000, a decade after their introduction. Two events were responsible for this gain in importance; first, after the tech bubbles of the end of the 20th century real assets regained the interest of investors and secondly, the tax exemption on income trust in 2006. Since the industry continued to grow and outperform many other asset classes. In 15 years, the industry market capitalization has been multiplied by more than 10 (in Canada), and with this trend came a lot of literature to fully understand the ins and out of this investment vehicle.

Benveniste, Capozza and Seguin (2001) managed to determine the value of liquidity in real estate. By studying REITs and their underlying assets, they found that creating liquidity leads to an increase of value of 12 to 22%. This article is a huge step toward understanding the pricing process of REITs. Clayton and McKinoon (2002) added to this finding by examining the relation between the Net Asset Value (NAV) and the price of REITs. They arrived at the conclusion that the liquidity premium in REITs prices relative to the NAV is dependent on the private real estate market. In other words, investors are willing to pay a bigger liquidity premium when the liquidity in the private real estate market is down. While liquidity levels in private real estate might be an indicator of REITs prices, past performance only shows weak sign of predictive power for future performance of equity REITs (Nelling and Gyourko (1998)) supporting the idea that REITs are closer to stocks than real estate. Indeed, Ang (2012) found low autocorrelation for both stocks (represented by the S&P500) and REITs returns but significant autocorrelation for real estate (0.78). However, it should be noted that the real estate asset class is represented by the NCREIF index (appraisal based) which could result in an overestimation of the autocorrelation. Nonetheless, REITs and real estate exhibit low correlation (0.1520), while REITs and stocks have a significant correlation (0.6265).

Even though stocks and REITs share some characteristics, indirect real estate (i.e. REITs) is inherently different and are driven by other fundamentals.

2.2.2. REITs and interest rates

One of these fundamentals is interest rates, and even though Canada has benefitted for a favourable interest rate environment for the best part of the last 20 years, investors should be aware of the impact of the variable on REITs performances. The research of Chmiel and Rodriguez (2019) on real estate provides interesting insight on the performance of REITs during rising interest rate periods: since 1998 Canada experienced 6 of such periods, and REITs outperformed the TSX index in only one occasion. But a possible solution for this problem is the selection of sectors within the equity REITs field. Asset classes such as self-storage, multi-family or industrial are regarded as "short term" assets, meaning that the leases range from months to a year, outperform other assets such as shopping centres or offices. Shorter leases allow for quicker rent adjustment and thus being less impacted by the rising costs associated with rising interest rates. Indeed, assets with leases shorter and 4 years had in average 24% of returns during rising interest rates periods, while assets with 8 years or more leases had 9% of returns since 1998. Though interest rates seem to be regarded as dangerous for real estate

returns, it is also an efficient predictor. For instance, several investors and analysts use the 10-year government yield as a proxy for the risk appetite and readiness of investors to invest in riskier asset classes. Thus, a rising 10-year GoC yield is associated with a decrease in real estate stocks returns. Logically, rising rates are linked to rising costs of debt and ultimately decreases in profitability of the real estate sector. However, the insightful research of Chmiel and Rodriguez (2019) tempers the usefulness of this indicator by introducing the BBB yield in the equation. They explain that "the Canadian-listed property sector is BBB-rated", and thus use this rating to infer real estate movements. By using the spread between BBB-rated bonds and the 10-year GoC, it is possible to predict the demand for REITs. When the spread widens (i.e. BBB-rated bonds and 10 years GoC grow apart) investors will lose their risk appetite and move away from REITs. The inverse relation is also true, when the spread compress, REITs will strive. The researchers behind this finding plotted the TSX capped REIT and the inverse of the spread and found strong co-movement. They estimated that the R_2 is 0.8.

Evidently, REITs are also driven by the similar macroeconomic metrics as real estate. Mainly, GDP growth, unemployment, wage growth and consumer price index.

2.2.3. Differences between equity and mortgages REITs

As stated before, REITs' performances are dependent on the sector of the REIT (residential, retail…) but also depending on the type of REIT. Brown (2000) studied the comportment of mortgages and equity REITs during the commercial real estate downturn of the late 1980s. He found that equity and mortgages REITs reacted differently to the downturn, mainly: "The data presented support the hypothesis that the real estate decline had a different effect on investment behaviour for mortgage and equity REITs. The average growth rate of total assets is -8.48 percent for mortgage REITs, 4.66 percent for hybrid REITs, and 14.93% for equity REITs.". While equity REITs continue to be solvent during this crisis period, mortgages REITs become insolvent. This insolvency steams from the inability and/or unwillingness to restructure the debts of financially distress companies. The asset that cannot be repay is then sold at a loss. Comparatively, equity REITs take this opportunity to buy undervalued assets and increases their future returns. Hence, mortgages and equity REITs face different challenges. The difference persists in the performance and diversification power of the two types. In 1987 Kuhle studied the matter and the results are clear: including either mortgages or equity REITs in a portfolio significantly reduce its risk. Furthermore, by changing the content of the portfolios, the authors proved that equity REITs provide have greater diversification power. He also found

that equity REITs outperform common stocks and mortgages REITs. Overall his studies provided significant proof of the potential of REITs, but more specifically equity REITs.

3. Data

In this research, the dataset is on a 16-year period, from January 2004 to December 2019.

The initial idea was to study a single 11-year period of investment (2009-2019). However, the subprime crisis had an effect on both the performance and the sentiment of investors toward real estate. To capture this effect, three periods are studied: the pre-correction (January 2004-December 2006), the correction (January 2007-December 2008) and the post-correction (January 2009-December 2019). While the post-correction period is considered to be the main period, the two others are essential and cannot be ignored. And again, the subprime crisis goes further than December 2008, but the Canadian real estate already displayed strong return in 2009. In an effort to capture only the "correction", only 2007 and 2008 are considered for the crisis/correction period. The decision to start the research in January 2004 is due to the lack of data on the Canadian private real estate market prior to 2004.

The inclusion of the pre-correction and correction period will allow the examination of two phenomena:

The impact of the investment period on the risk of the apartments portfolios and the effect of crisis on the risk and return profile of REITs. The data is treated as three distinct periods.

3.1. Real assets

To represent investments in real assets, this research studies the evolution of portfolios of apartments, in 4 cities in Canada: Montréal, Ottawa, Toronto and Vancouver. The portfolios each contain a mix of 3 types of apartments: studios, 1-bedroom apartments and 2-bedroom apartments. The data on each apartment type and cities has been retrieved from the SCHL (Société Canadienne d'Hypothèques et de Logement) and the CREA (Canadian Real Estate Association).

3.1.1. Rents and inoccupancy rates (SCHL)

The SCHL has a substantial database on the rental market in Canada. They publish, on a yearly basis, statistics on the rental market, in particular the evolution of rents and inoccupancy rates. Those two variables are of interest for this research, as the performance of portfolios of apartments are monitored. They collect data with a survey (the "Rental Market Survey" or RMS), on every urban area with 10'000 inhabitants or more. The survey is done on a sample

basis and on privately owned structures with at least three rental units. It is conducted in October every year. Thus, the statistics on average rents and inoccupancy rates of the previous end of the year is used as a proxy for the next year's rents (i.e. Average rents of October 2003 are an estimate of the rents during 2004). Here it is assumed that the leases in each apartment of the portfolios start January 1st and last 1 year. In the following year, the rents will change according to the next average rent in the cities (and or neighbourhood). Thus, the RMS published by the SCHL provided average rents and inoccupancy rates for the studied periods. The data provided by the SCHL is granular enough to conduct this study. In this database of the SCHL, one can access the average rent, per neighbourhood of dozens of different cities. Thus, it is possible to select a neighbourhood to study in each of the 4 cities of interest and follow its evolution from 2004 to 2019. Additionally, the SCHL adds the statistical significance of each number. The grade system goes from A (excellent reliability) to D (fair reliability) and are computed with the coefficient variation. The coefficient variation is the ratio of standard error on average rent. ($CV = \sigma \bar{x} / \bar{x}$). In this paper, only A graded numbers are used.

3.1.2. Evolution of asset prices (CREA)

The other major element in real estate is the evolution of prices of the apartments. The Canadian Real Estate Association (CREA) created, in association with various real estate associations around Canada, the MLS House Price Index (MLS HPI). This index monitors the changes in prices of single-family homes, townhouses/row units and apartment units in 18 markets in Canada. The MLS HPI uses a mix of repeat sales and hedonic price approaches.

The repeat sales approach, used by the well-known S&P/Case-Shiller HPI in the US, is based on actual sales of properties over time. The indexes using this method use sales data of the units sold at least twice during the study period and aggregate them by neighbourhood or city to get the evolution of prices. While this method is an improvement over appraisal-based indexes because it relies on actual sales, it also has its fair share of downsides. First, taking only properties that have been sold at least twice greatly reduce the size of the sample. Moreover, indexes using repeat sales are often lagged, because of the scarcity and difficulty to collect data. Finally, this method omits the possible changes in characteristics of the property between two sales. Assuming that every property keeps the same features (no renovation) in between sales seem improbable. To resolve this issue, the MLS HPI uses the hedonic method as well. This approach premises that prices are impacted by internal and external factors. Thus, properties' features are accounted for with the hedonic approach.

The effort of mixing repeat sales and hedonic approaches is certainly an improvement over "simple" appraisal or repeat sales-based indexes. However, the readers should keep in mind that we are talking about aggregates of different areas in a highly heterogeneous market. Hence, this paper's aim is not to conduct a case study on a specific building, but rather to understand the overall evolution and profitability of real estate in a given period.

3.1.3. Other relevant data (costs, taxes and loan)

When estimating revenues of real assets, it is essential to account for the costs that the investors will face. Some of the principal costs a landlord is facing are properties taxes, insurance, repairs and tenants acquisition. Estimating some of these costs is quite challenging, fortunately, real estate agencies often offer property management services which can be used to approximate the cost that a landlord will face. Real estate agencies typically charge between 8-12% of the rent. Furthermore, in this study, it is assumed that the investor holding a portfolio of apartments is using the service of a property management company. Evidently, the investor could be managing his properties and drastically reducing these costs. However, this paper compares investments in the stock market and real assets and to do so, the investor should invest an equal amount of money and time in both alternatives. Hence, hiring a real estate agency is needed to alleviate the time spent on the, otherwise, labor intensive task that property management is. Thus, the overall monthly costs are assumed to be 10% of the rental income.

The question of taxes is also of interest in this study. In this paper, the investors do not use any type of business entity to invest in real estate. The rental income and capital gain are taxed with their personal income. In Canada, capital gain and rental income are taxed differently. Any capital gains (on private real estate or stocks) are taxed up to 50%. Thus, if an investor had a capital gain of $1000, only $500 will be taxed. And those $500 will be taxed at the relevant tax rates, which are determined according to the investors' annual income. For the rental income, it constitutes the annual income of the investor. Hence, 100% of the rental income is taxed at the relevant tax rates. Evidently, the costs associated with the private real estate investment, such as management, maintenance or even interest on loan payments, can be subtracted from the rental income to reduce taxes. In this paper, these tax reductions are accounted for. Thus, the apartment portfolios are subject to double taxation, the rental incomes and the capital gains are taxed. For the REITs portfolio, only the capital gains can be taxed.

The data used on historical taxes rates and brackets come from the archives of the Canadian government (for federal rates) and of the Quebec province (for provincial rates) available on

both their websites. Additionally, the apartment portfolios are subject to property taxes. In Canada, property taxes can range from 0.5% to 2.5% of the property value depending on the neighbourhood. In this paper, it is assumed that the property tax amount to 1.5% of the property value and are paid annually.

Lastly, as mentioned earlier, to fully replicate the investments of a residential REIT, it is needed to utilize leverage. In this paper, several levered portfolios are built, using historical interest rates. Those rates have been retrieved from the Banque of Canada.

3.1.4. Stock data

The second investment means are Real Estate Investment Trusts (REITs). In order to efficiently compare the real assets at hand and REITs only residential REITs are used. The universe of REITs is limited due to the novelty of the asset class in Canada and more so for the residential REITs. Over the 16 years of the studied period, 13 residential REITs existed. As of January 2004 (beginning of the pre-correction period), 6 residential REITs were on the Canadian stock exchange, and on December 31, 2019 (end of the main period), 10 were traded. In the span of 16 years, the market capitalization of the industry (residential REITs) has been multiplied by more than 11. The REIT industry as a whole grew from 16 billion in early 2005 to 120 billion by the end of 2019. This developing interest of investors has also been motivated by the strong performance of the asset class. Since 1998, the TSX Capped REIT index has had 11,4% of compounded return, which is 2,3% more than US REITs and the index outperformed the S&P/TSX 13 out of those 21 years (4,6% more compounded return).While this asset class seems promising, it is still growing, and is lacking industry specific indexes. Thus, in this paper, a residential REITs index is built to analyze the profitability of this sector, using every residential REITs on the studied periods. On top of these 13 residential REITs, 17 other securities have been studied. In particular indexes such as the S&P500 and the S&P/TSX or fixed income securities (from the US and Canada) to allow for an in-depth comparison of their returns with the real assets and REITs portfolios. Finally, 8 REIT ETFs (4 Canadian and 4 American) and the FTSE Nareit All Equity REITS are used as a comparison to the residential REITs portfolio. Table 1 summarizes every security used in this research as well as the date of the first data point for each security.

The data is retrieved from January 2, 2004 to December 27, 2019 on a weekly basis. Each data point represents the total return, meaning that every dividend received is assumed to be reinvested upon reception. Finally, market capitalization of each residential REITs on a

quarterly and annual basis is used to construct the index. Table 2 displays the composition of the portfolio of the Boardwalk REIT which is one of the major Canadian residential REITs, and thus constitutes a large part of the residential REITs portfolio constructed in this paper. As of 2019, Boardwalk's portfolio is composed of more than 33,000 apartment units across 4 Canadian provinces. The apartments range from standard units to exclusive luxurious units. Hence, table 2 allows the reader to get an idea of the importance and geographical diversification of REITs. Again, the aim of this paper is not to conduct an apple-to-apple comparison of REITs and private real estate investments, but rather to assess the profitability of each alternative.

REITs own billions worth of real estate, and while it would be possible to narrow down one building and to compute its profitability from an individual investor's standpoint, it is then impossible to dissociate this property from the rest of the REIT's portfolio. REITs' portfolios are indivisible, making it impossible to conduct an apple-to-apple comparison.

Table 1. Securities in the dataset

Security	Ticker	Starting date
Canadian Residential REITs		
Boardwalk REIT	BEI-U CN Equity	02.01.04
Killiam Apartment REIT	KMP-U CN Equity	02.01.04
Cap REIT	CAR-U CN Equity	02.01.04
Northview Apartment REIT	NVU-U CN Equity	02.01.04
Interrent REIT	IIP-U CN Equity	02.01.04
Minto Apartment REIT	MI-U CN Equity	13.07.18
European Residential REIT	ERE-U CN Equity	14.10.16
Morguard North American Residential REIT	MRG-U CN Equity	27.04.12
BSR REIT	HOM/U CN Equity	25.05.18
Lanesborough REIT	LRT-U CN Equity	02.01.04
Pure Multi-Family REIT	RUF/U CN Equity	20.07.12
Milestone Apartment REIT	MST-U CN Equity	15.03.13
True North Apartment REIT	TN-U CN Equity	22.06.12
American and Canadian Real Estate ETFs		
iShares SPTSX Capped REIT Index	XRE CN Equity	02.01.04
CI First Asset Canadian REIT ETF	RIT CN Equity	26.11.04
BMO Equal Weight REITs ETF	ZRE CN Equity	04.06.10
Vanguard FTSE Canadian Capped REIT ETF	VRE CN Equity	16.11.12
ETF on FTSE Nareit All Equity REITS	USRT US Equity	11.05.07
Vanaguard Real Estate Index Fund	VNQ US Equity	08.10.04
Schwab US REIT ETF	SCHH US Equity	21.01.11
Ishares US Real Estate ETF	IYR US Equity	02.01.04
Indexes		
SPTSX (Index)	SPTSX Index	02.01.04
S&P 500 (Index)	SPX Index	02.01.04
FTSE Nareit All Equity REITS (Index)	FNER Index	02.01.04
ETFs		
Ishare SPTSX ETF	XIU CN Equity	02.01.04
Ishare S&P 500 (CAD Hedged)	XSP CN Equity	02.01.04
iShares Core Canadian Universe Bind Index ETF	XBB CN Equity	02.01.04
iShares Canadian Corporate Bond Index ETF	XCB CN Equity	17.11.06
Ishares US IG Corporate Bond Index ETF	XIG CN Equity	05.02.10
iShares US High Yield Bond Index ETF	XHY CN Equity	05.02.10

Note: All the ETFs and indexes are used for comparison purposes

Table 2. Boardwalk's portfolio composition

Cities	Number of units	% of portfolio
Edmonton-Saint Albert- Spruce Grove	13,030	39.2
Clagary-Airdrie-Banff	5,956	17.9
Montréal	4,681	14.1
London-Kitchener	2,585	7.8
Regina	2,046	6.1
Saskatoon	1,710	5.1
Québec City	1,319	4.0
Red Deer	939	2.8
Grande Prairie	645	1.9
Fort McMurray	353	1.1
Total	33,264	

4. **Methodology**

4.1. **Real assets portfolios**

As mentioned earlier, this paper aim is to compare investments in real assets and in the stock market. To do so, 20 portfolios of apartments have been constructed in 4 cities of Canada. Each portfolio has been built with the MLS HPI (index) and data from the SCHL on the rental market. However, the MLS HPI has limitations, mainly in the categories of properties. The index follows single-family homes, one and two storeys single-family homes, townhouse/row units and apartments. The variable of interest is the apartment index, but this category includes Single Level Apartment, Multi-Level Apartment, Loft, Penthouse, Duplex, Triplex and Studio Suite. Thus, the apartment index is informative on the change in price of an aggregate of different types of apartments. In this paper, the apartment portfolios are constituted of studio, 1-bedroom and 2-bedroom apartments. Additionally, the index lacks geographic precision, each of the 18 markets followed by the MLS HPI are cities. For instance, one of them is "Greater Montréal" which include dozens of neighbourhoods in Montréal. Hence, the index is an aggregate of apartments in multiple neighbourhood of cities. From all this information, only the monthly price of the "average" apartment is given. For example, in November 2019, the average apartment in the Greater Toronto area was valued at $554'800.

To overcome this, and to allow for more precis results, one neighbourhood, the downtown area, in each city is selected. Then, the question is: what is the price of each apartment type in those neighbourhoods? To answer this question, 257 apartment listings have been retrieved from various real estate website from January 15th to January 22, 2020. These prices are used as proxies for prices at the end of December 2019 (month in which the investor is supposed to sell his apartments). From this data, the average listing price of each apartment type in each city for the downtown area is retrieved. This average is used as the price of the apartment type as of December 2019 in each area. Thus, the listings from January 2020 are used to compute an average selling price for each apartment type in the area of interest in each city. At this point, it is assumed that every apartment type in the same city appreciate at the same rate. While the part of the assumption that studio, 1-bedroom and 2-bedroom apartments appreciated at the same rate since 2004 is plausible, the second part of the assumption, which states that every neighbourhood of each city appreciate at the same rate, is unlikely but necessary given the data at hand. With this assumption, the price of each apartment type since 2004 can be computed for each area of interest (i.e. the downtown neighbourhood of each city).

Fortunately, the data on the rental market from the SCHL is more granular. It was possible to retrieve the average rent per apartment type per neighbourhood. It is worth noting that the heterogeneity of the real estate market is such that apartments classified in the same type (studio, 1-bedroom…) can have drastically different features and thus different valuation. This heterogeneity is not accounted for in this paper.

The idea behind choosing 4 different cities is to create a geographically diversified portfolio of apartment containing at least one apartment in each city. For each period (2004-2006, 2007-2008 and 2009-2019) five portfolios have constructed, four portfolios containing apartments in only one city and 1 portfolio containing apartments in all four cities. The budget for the five portfolios is the same, a million dollars, but the selection of the type of apartment in each portfolio varies between the pre-correction and correction periods and the post-correction period. While maximization under constraints is used for each period, the constraints differ. The idea is to use the data from 2004 to 2008 to maximize the profitability of the portfolio in the post-correction period. To do so, a profitability factor (Π) is added to the maximization. The addition of the profitability would, in theory, allows for the investor to select the best performing type of apartment in each city. While it is assumed that the rate of appreciation of each apartment type is the same (due to the lack of data), the evolution of rents is different. Thus, one can gather the information on the rents' evolution per apartment type from 2004 to 2008 and look at which type is the most profitable. That is what the profitability factor (Π) is for. In reality, the budget constraint is such that the profitability factor does not change the maximization result in the majority of the case. The only case where the inclusion of the profitability factor has an impact on the results is in Ottawa. For the rest of the portfolios, finding combinations of apartments that maximize the budget constraint is the only factor taken into account. For instance, in Vancouver, the price of apartments, in 2009, are such that the only combination of apartments that maximize a million dollars is : one studio, one one-bedroom apartment and one two-bedroom apartment. Thus, the results of the maximization with and without the profitability factor are the same, except for Ottawa.

In the pre-correction and correction periods, the goal was to find a mix of apartments with a valuation of a million dollars taking into account the prices of each apartment type.

$$\max_{N} \sum_{j} N_{i,j,t} \times C_{i,j,t} \; s.t. \; N_{i,j,t} \times C_{i,j,t} \leq B_{i,t}$$

Where :

N=Number of apartment

C=Cost of the apartment

B=Budget

i=City

j=Type of apartment

t=Time

For the diversified portfolio (i.e. the portfolio that contains apartments all over Canada) the maximization includes the constraint to buy at least one apartment per city.

$$\max_N \sum_j N_{i,j,t} \times C_{i,j,t} \; s.t. \, N_{i,j,t} \times C_{i,j,t} \leq B_{i,t} \; and \; N_{i,t} \geq 1$$

In the post-correction period, the data from 2004 to 2008 was used to maximize the overall value of the portfolios (getting as close as possible to a million dollars) but also to include the profitability of each apartment type in the maximization.

$$\max_N \sum_j N_{i,j,t} \times \Pi_{i,j,t} \; s.t. \, N_{i,j,t} \times C_{i,j,t} \leq B_{i,t}$$

$$\Pi = \frac{R + (V_T - V_0)}{V_0}$$

Where :

Π=Profitability

R=Rent income

V_t=Value of the apartment at time t

And, in the geographically diversified portfolios of apartments for the second period, the constraint to buy at least one apartment per city remains:

$$\max_N \sum_j N_{i,j,t} \times \Pi_{i,j,t} \; s.t. \, N_{i,j,t} \times C_{i,j,t} \leq B_{i,t} \; and \; N_{i,t} \geq 1$$

4.1.1. Unlevered apartment portfolio

In the case of the unlevered portfolios of apartments, the model to estimate the return of each portfolios is straight forward. The MLS HPI has the monthly evolution of the price in each cities, and the SCHL annual publication of the rents per apartment type per neighbourhood is used as a proxy for the monthly rent of the next year (e.g. Rents in the SCHL publication of the end of 2010 is used as a proxy for rents in 2011). Hence, by adding the monthly rents and subtracting costs and accounting for the inoccupancy rates of each cities, the Net Operating

Income (NOI) per unit is calculated. The total return is then computing by adding the appreciation of the apartment in the given period.

While the returns are fairly easy to estimate, the variance of the returns need more attention. Dozens of articles on real estate returns and risk would argue that calculating the variance of returns without accounting for liquidity risk is inherently wrong. In this paper the variance formula, adjusted for liquidity and price risks, is borrowed from Lin, Liu and Vandell (2009):

$$\sigma_{adjusted}^2 = T_H \times \sigma_{portfolio}^2 + t_{TOM} \times \sigma_{portfolio}^2 + \frac{t_{TOM}^2}{T_H + t_{TOM}} \times (1 + \frac{u^2}{\sigma^2}) \times \sigma_{portfolio}^2$$

Where :

T_H=Investment holding period

t_{TOM}=Time on the market

u=Return of the index

σ_2=Variance of the index

$\sigma_{2portfolio}$=Variance of the portfolio

$\sigma_{2adjusted}$=Adjusted variance of the portfolio

The idea behind this formula is to incorporate the two opposite forces that are price and liquidity risks in the variance of the return. While the liquidity risk is mitigated by time, the price risk grows as the holding period increases. This reflects the non iid nature of the returns of real estate, in other words, the risk is holding-period dependent. The authors found three sources of risk: ": 1) the growing uncertainty of the future price due to a relatively long holding period, 2) the additional price uncertainty due to the extra holding time necessary to sell (i.e., expected TOM), and 3) the uncertainty of the timing of sale". Finally, they chose to account for the first and second moment of the TOM in the adjusted risk formula. The end result is the formula that is used in this research.

4.1.2. Levered apartment portfolio

As previously stated, Canadian residential REITs have an average debt to book value of 41%. In an effort to reproduce this debt structure, levered portfolios of apartments are constructed. For each of the five levered portfolios, a loan of 410,000 is undertaken. This way, the leverage effect is accounted for and it will be possible to determine if the returns of REITs come from adequate management and investments or from the use of debt to increase profitability. Evidently, private real estate investors utilize the leverage effect to maximize their return. Their loan to value ratio is closer to 80% than 41%. However, the aim here is to reproduce the capital

structure of REITs, not those of real estate investors. Note that leverage portfolios have only been built for the post-correction investment period (2009-2019). The shorter investment duration of the pre-correction and correction periods are not appropriate to profitably undertake a loan. The repayment of the loan almost amounted to the extra profit generated with the apartments bought with the loan.

In this research, all the rental incomes are used to cover the monthly payment of the loan. For each of the 5 portfolios, the monthly rental income net of costs, taxes and including the inoccupancy rates are accounted for in the choice of the loan. Evidently, an investor cannot possibly predict with 100% accuracy how the real estate market and thus the rents will evolve, and ultimately decide on monthly payment to minimize the term of the loan. To overcome this uncertainty, the data from 2004 to 2008 has been used to approximate future rents. But predicting 11 years of evolution of the rental market with 5 years of data is nearly impossible. So it is assumed that the rental market would not go under its December 2008 level. One could argue that assuming that the rental market will not decrease in the midst of the subprime crisis is incorrect, but the impact of this crisis on Canadian residential real estate was mild compared to the US.

And even though the market would have been hit by the crisis after 2008, like every crisis, it was deemed to go back up again in the near future. Hence, the monthly payment of the loan of $410'000 is based on the rents of the end of 2008. For each portfolio, the term of the loan has been minimized to pay the lowest interest possible. The model also includes the benefits of undertaking a loan, mainly the tax returns.

The portfolio construction is similar to those in the unlevered portfolios, maximization under constraint, taking into account the budget and the profitability of each apartment type in each city. The variance is computed with the price and liquidity risk adjustments.

While the use of debt allows for a fair comparison of return with REITs, the time and effort spent getting a loan and managing apartment and the increase risk associated with the reimbursement of the loans are not comparable to investing the stock market. The levered portfolios are only included to try to explain the excess return of REITs.

In both, levered and unlevered, portfolios, the investor will be subject to taxes. The investors do not use any corporative structures and their rental income and capital gains are taxed at the relevant-tax rates for their taxes brackets. The management and repairs costs as well as the interest paid on the loan are subtracted from the rental income to reduce taxes.

4.2. REITs portfolios

As described in the data section, every REIT security belongs to the residential REIT universe. The rest of the securities studied are ETFs or indexes. The portfolio of REITs is constructed as a capitalization-weighted index on the residential REIT market. Two indexes are built with different rebalancing period, quarterly and annual.

$$R_t = \sum_i R_{i,t} \frac{W_{i,t}}{\sum_i W_{i,t}}$$

Where :

R_t=Return of the index

R_i=Return of REIT i

W_i=Market capitalization of REIT i

The data on market capitalization was only available on a quarterly basis. In our situation, and because we are presuming that independent investors are managing their portfolio, this constraint on the rebalancing period is not a problem. It is realistic to assume that an independent investor rebalances his portfolio once every quarter. The second, annually rebalanced, portfolio's purpose is to evaluate if rebalancing quarterly is optimal. The costs associated with rebalancing have not been accounted for here as they are negligible. On the other hand, taxes on capital gain is included in the model. The investor is based in Quebec, thus paying taxes accordingly. Taxes on capital gains are paid upon sale of the asset and 50% of the capital gain is taxable. For instance, an investment of $1000 sold at $2000, the taxable gains will be of 50%, $500 in this case. Then, the tax rates depend on the income brackets. It is safe to assume that, the year in which all the assets are sold, the investor will be in the highest tax bracket, but this will be reviewed at the end of the investment period to insure proper tax payment. This calculation will be used to compute after taxes profit on the investment in the stock market.

5.   Results and interpretations

5.1. Apartment portfolios

5.1.1.   Unlevered portfolios

The figures presented below show the evolution of the value of each portfolio in each city for the three periods. As mentioned earlier, the pre-correction and correction periods, can be perceived as test periods in the sense that there are displayed to mitigate the results of the main period (2009-2019). The reader should keep in mind that post-correction periods are associated with strong growth of the economy, and thus in real estate. It is necessary to display the portfolio's return in different parts of the economic cycle. In the results section of this paper, the post-correction period is studied first, then the results of the period are mitigated with the pre-correction and correction periods. Table 3 describes the composition of each portfolios for the 3 periods.

Figure 1 displays the evolution of the 5 portfolios during the post-correction period. While the portfolios in Ottawa and Montréal profited from a steady growth, Vancouver and Toronto experienced strong growth and strong variance. Table 2 offers precise risk and return measurements. Note that the adjusted variance is calculated on the hypothesis that the time required to sell the apartments (time on the market, abbreviated as TOM) at the end of the period is 6 months. Table 4 exhibits the degree to which the unadjusted volatility is underestimated. The adjusted volatility is on average more than 3 times the unadjusted volatility in every portfolio. The Sharpe ratio illustrates the risk-return profile of each portfolio, with Montréal profiting from the lowest volatility and the best ratio. In the meantime, the important volatility of the Vancouver investment, between 2017 and 2019, significantly reduce the risk-return ratio. While Vancouver is the third most profitable portfolio, its volatility (adjusted) is 3 times as important as the one in Montréal. The strong return, and volatility, in Toronto and Vancouver between 2015 and 2017 can be attributed to foreign investments in real estate. The number of these non-resident investors exploded, saturating both markets and driving the price of real estate through the roof. In 2018, both cities' markets slowed because of new laws for foreign investors, explain the decline in the return.

Overall, the diversified portfolio seems to be the most viable option, with high returns and relatively low volatility, which is in line with the diversification benefits widely discussed in finance.

Table 3. Composition of the portfolios of apartments

	Studio	1 Bedroom	2 Bedroom	Total
A. Portfolios in the pre-correction period (2004-2006)				
Ottawa	6	1	0	7
Montréal	4	0	3	7
Toronto	1	1	3	5
Vancouver	3	2	0	5
Diversified	0	1	4	5
Ottawa	*0*	*0*	*1*	*1*
Montréal	*0*	*1*	*1*	*2*
Toronto	*0*	*0*	*1*	*1*
Vancouver	*0*	*0*	*1*	*1*
B. Portfolios in the correction period (2007-2008)				
Ottawa	4	2	0	6
Montréal	4	0	2	6
Toronto	0	0	4	4
Vancouver	1	1	1	3
Diversified	1	0	3	4
Ottawa	*0*	*0*	*1*	*1*
Montréal	*1*	*0*	*0*	*1*
Toronto	*0*	*0*	*1*	*1*
Vancouver	*0*	*0*	*1*	*1*
C. Unlevered portfolios in the post-correction period (2009-2019)				
Ottawa	3	1	1	5
Montréal	1	4	0	5
Toronto	1	0	3	4
Vancouver	1	1	1	3
Diversified	1	2	1	4
Ottawa	*0*	*1*	*0*	*1*
Montréal	*1*	*0*	*0*	*1*
Toronto	*0*	*1*	*0*	*1*
Vancouver	*0*	*0*	*1*	*1*
D. Levered portfolios in the post-correction period (2009-2019)				
Ottawa	0	3	3	6
Montréal	2	3	2	7
Toronto	2	1	3	6
Vancouver	4	1	0	5
Diversified	1	1	3	5
Ottawa	*0*	*0*	*1*	*1*
Montréal	*1*	*0*	*0*	*1*
Toronto	*0*	*0*	*1*	*1*
Vancouver	*0*	*1*	*1*	*2*

Figure 1. Evolution of an investment of $1,000,000 in apartment portfolios, 2009-2019
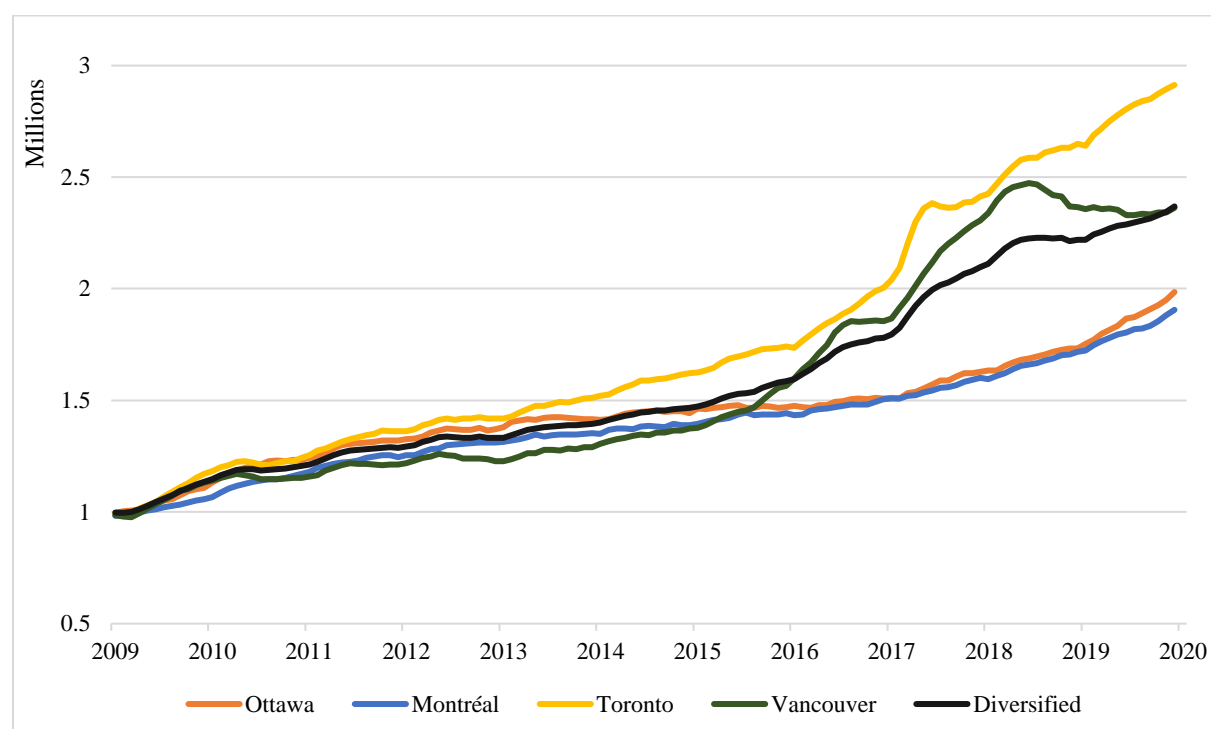
Table 4. Descriptive statistics of the apartment portfolios, 2004-2019

	Return	Volatility	Adjusted volatility	Sharpe ratio
A. Performance 2004-2006				
Ottawa	7,59%	1,00%	2,14%	3,56
Montreal	9,15%	1,79%	3,84%	2,39
Toronto	8,14%	1,34%	2,87%	2,84
Vancouver	15,15%	2,53%	5,40%	2,80
Diversified	10,48%	1,38%	2,94%	3,56
B. Performance 2007-2008				
Ottawa	10,68%	2,05%	4,11%	2,60
Montreal	9,25%	1,50%	3,01%	3,08
Toronto	9,14%	2,29%	4,58%	1,99
Vancouver	3,14%	4,88%	9,77%	0,32
Diversified	7,43%	2,67%	5,34%	1,39
C. Performance 2009-2019				
Ottawa	6,47%	4,41%	15,03%	0,43
Montreal	6,20%	2,88%	9,84%	0,63
Toronto	10,28%	5,47%	18,65%	0,55
Vancouver	8,26%	8,52%	29,06%	0,28
Diversified	8,18%	4,70%	16,02%	0,51

Considering the subprime crisis, it is legitimate to ask ourselves if the real estate market experienced abnormally high returns in the 11 years following 2008. To answer this question, it is important to look, first, at the impact of the crisis on the Canadian economy, and more specifically on the real estate market and second to study the annual returns of real estate in Canada, before and after the crisis.

The Canadian economy and real estate market were less impacted than the American ones. And table 5, which displays annual return from 2004 to 2019, indicates that only the year 2009 benefited from a rebound from the economy.

Figures 2 and 3 displays the evolution of the 5 apartments portfolios both in the pre-correction and correction periods. The growth of every apartment portfolios was impacted, but Vancouver experience a significant decrease in value, while the other 3 cities experienced mild effect. Again, this illustrates the heterogeneity of the real estate market. In the pre-correction period, the risk-return ratios are very attractive (table 4). While the returns are significant, it is the low variance that allows for such Sharpe ratio. As stated before, the adjusted volatility includes liquidity and price risks, but it seems that even the adjusted volatility underestimates the risk. Note that in both periods, the TOM is assumed to be 6 months as for the post-correction period. However, the difference between the volatility (both unadjusted and adjusted) in the pre-correction and correction periods allows to gauge the impact of the subprime crisis on the risk. Between the two periods, the risk almost doubled in every city. The only exception is Montréal, where the volatility decreased in the correction period. Overall, table 4 illustrates the profitability of the apartments portfolios throughout the 2004 to 2019, with solid returns even during one of the worst real estate crisis.

Table 5. Annual return of the apartment portfolios, 2004-2019

	Ottawa	Montréal	Toronto	Vancouver	Diversified
A. Annual return in pre-correction period					
2004	11,40%	13,90%	9,68%	14,34%	12,87%
2005	5,25%	7,69%	8,82%	17,34%	10,19%
2006	6,41%	7,03%	6,99%	15,76%	9,57%
B. Annual return in the correction period					
2007	12,40%	9,45%	13,37%	15,25%	13,57%
2008	8,99%	9,06%	5,06%	-7,70%	1,63%
B. Annual return in the post-correction period					
2009	13,81%	8,54%	19,16%	15,63%	14,95%
2010	9,66%	10,66%	5,94%	1,57%	5,80%
2011	6,77%	6,19%	8,56%	5,30%	6,57%
2012	4,00%	4,82%	4,11%	0,73%	3,04%
2013	2,49%	2,71%	7,33%	6,16%	5,14%
2014	3,48%	3,37%	6,81%	5,52%	5,13%
2015	0,82%	2,77%	6,84%	16,09%	8,37%
2016	2,34%	5,27%	17,49%	16,75%	12,40%
2017	8,22%	5,60%	18,88%	25,43%	17,76%
2018	7,24%	8,12%	8,95%	0,71%	5,05%
2019	13,29%	10,56%	10,27%	0,21%	6,72%

Figure 2. Evolution of an investment of $1,000,000 in apartment portfolios, 2004-2006
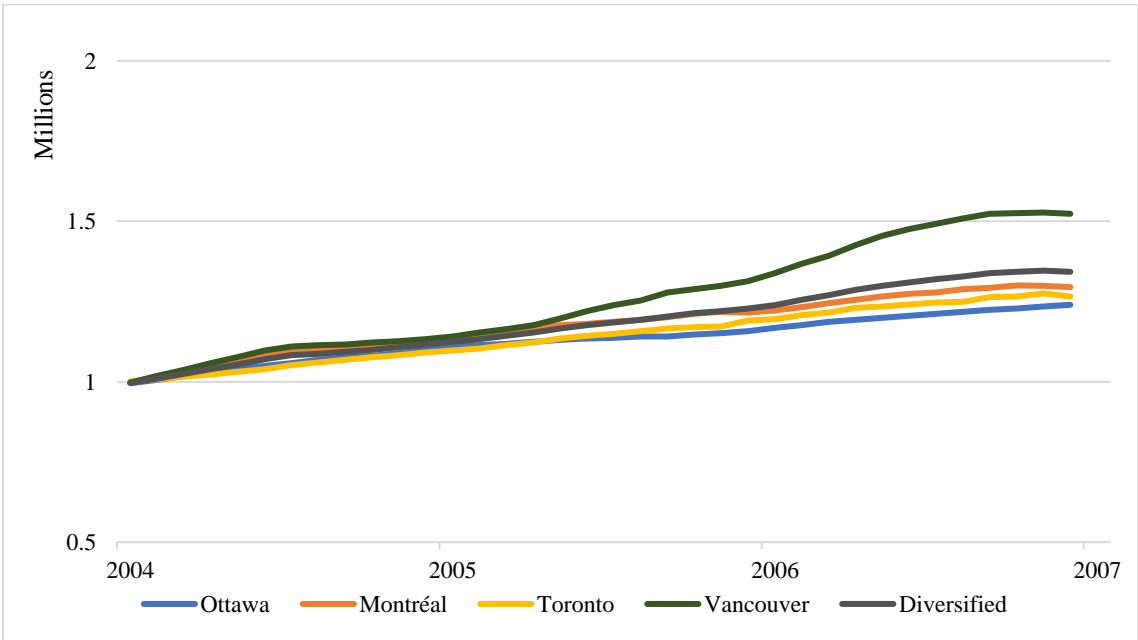
Figure 3. Evolution of an investment of $1,000,000 in apartment portfolios, 2007-2008
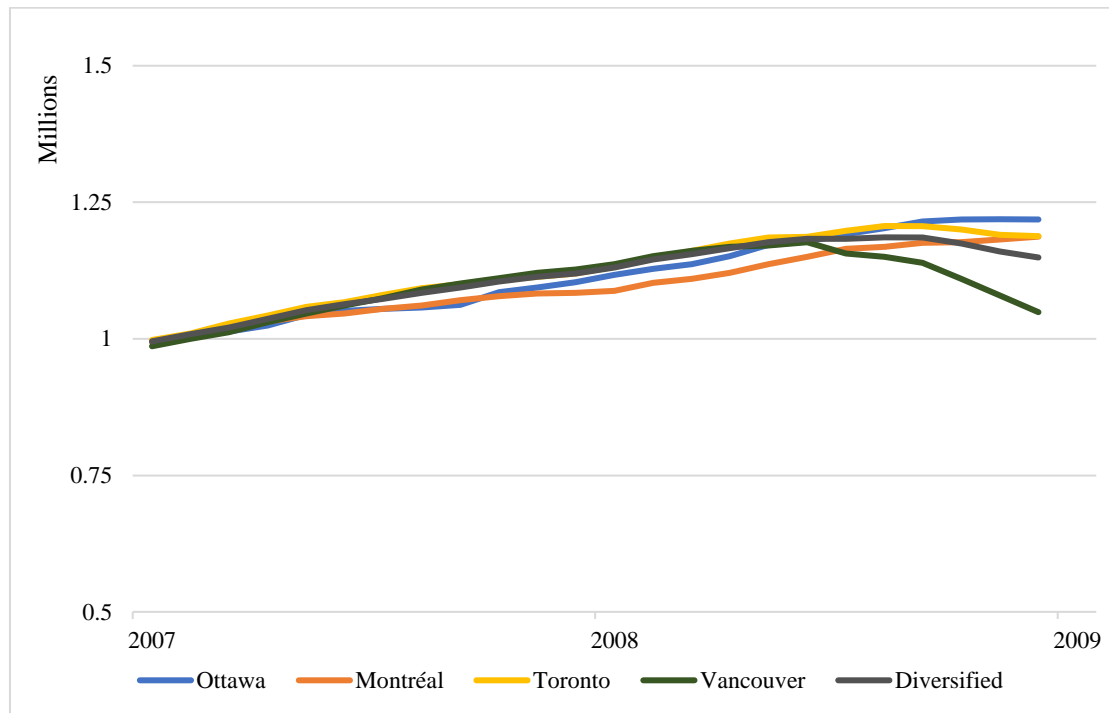
All in all, it is safe to say that the subprime crisis had an impacted in Canada and that real estate benefited from a rebound in the start of the study period (2009). However, the performance of the portfolios from 2010 to 2019, can hardly be attributed to a post-correction growth, but rather to the profitable character of residential real estate.

The pre-correction and correction periods also allow for a comparison the adjusted volatility for different holding period. Indeed, the authors who found the formula based it on the non iid nature of real estate return. They decided to include both the illiquid character of the asset class and the price risk. While, the non idd hypothesis can easily be proven true, finding a formula accommodating both price and liquidity risk is more challenging. This issue steams from the facts that both risks react differently to time. Liquidity risk, which translates the time needed to sell the asset, is mitigated with time: the longer the holding period is, the better it is to spread the risk. For instance, if we assume that the TOM needed to sell an apartment is two months, this TOM is true for an investor that had his apartment for 10 years or 1 year. However, if the investor had the apartment for 10 years, he can amortize this risk on all these years. And on the other hand, the price risk increases with time: as the holding period increases, the uncertainty associated with the value of the asset increases as well.

In this paper, for the pre-correction and correction period, the adjusted volatility is underestimated. The problem comes from the dataset used to compute the portfolios and the model. The model assumes that rents change only once a year which restricts the variation in value of the portfolios. Secondly, the price movement of apartments in each city is captured by an index. While the MLS HPI utilizes the hedonic and repeat-sales approaches, and is superior to appraisal-based indexes, it remains that the index greatly underestimates the variance of the real estate markets. It seems that the volatility formula is greatly impacted by the duration of the investment. In table 4, the investment duration in the post-correction period (11 years) is far superior to the one in the correction period (2 years). While the price risk could explain this discrepancy, the results are still questionable. Overall, the adjusted risk is definitely an improvement over the unadjusted volatility, but the formula could use modifications. Mainly, to mitigate the effect of the price risk in the long run.

While the risk is a difficult variable to estimate in the real estate case, the returns are easily computable. And here the results are clear, the portfolios had solid returns throughout the 16 years. Even in the financial meltdown of 2008, the portfolios managed to have positive returns in correction period (2007-2008), demonstrating the resilience and attractiveness of private real estate.

5.1.2. Levered apartments

In this section, the levered portfolios are only studied in the post-correction period (2009-2019). The shorter investment duration of the pre-correction and correction periods are not appropriate to profitably undertake a loan. The repayment of the loan almost amounted to the extra profit generated with the apartments bought with the loan. As stated before, the loans are all for $410,000, to replicate the residential REITs debt level of 41%. This loan is repaid with the rental income of apartments in each portfolio. Because the rental income diverges across cities, the repayment and thus the loans vary as well. The goal is to minimize the interests paid on the loan, with the rental income. The interest rates on the loans are those in effect in January 2009 (when the loans were started). The minimization resulted in 2 different loans. For the Vancouver and Montréal portfolios, the loans are on 13 years, with $159,850 paid in interest. For the Toronto, Ottawa and diversified portfolios, the loans are on 11 years, with $133,295 paid in interest. While each portfolio has a different composition than the unlevered ones, it is unsurprising to see similar results as the apartments follow the same evolution over the 11 years. Thus, the Toronto portfolio is the best performing, followed by the

diversified and the Vancouver portfolios. The Ottawa and Montréal are still very similar their appreciation and variance. Figure 4 represents the evolution of price of real estate before the loan repayment. Table 6 displays the risk and return profile of each levered portfolio. Unsurprisingly, the loans allowed for a higher rate of return for every apartment but not without drawbacks. Each portfolio experienced an increase in unadjusted and adjusted volatility. Overall, only the Montréal, Ottawa and Toronto portfolios' Sharpe ratios improved. For Vancouver and the diversified portfolio, the increase in return are not enough to offset the sharp increase in volatility. Unquestionably, the levered portfolios are more profitable than their analogous unlevered portfolios. However, the increases in volatility are non-negligible and these risk measures do not include the added risk due to the loan. From a profitability standpoint, this is an interesting investment. But in reality, undertaking a loan and being exposing to the risk of insolvency due to bad market condition can easily offset the extra profits.

Figure 4. Evolution of an investment of $1,410,000 in apartment portfolios, 2009-2019
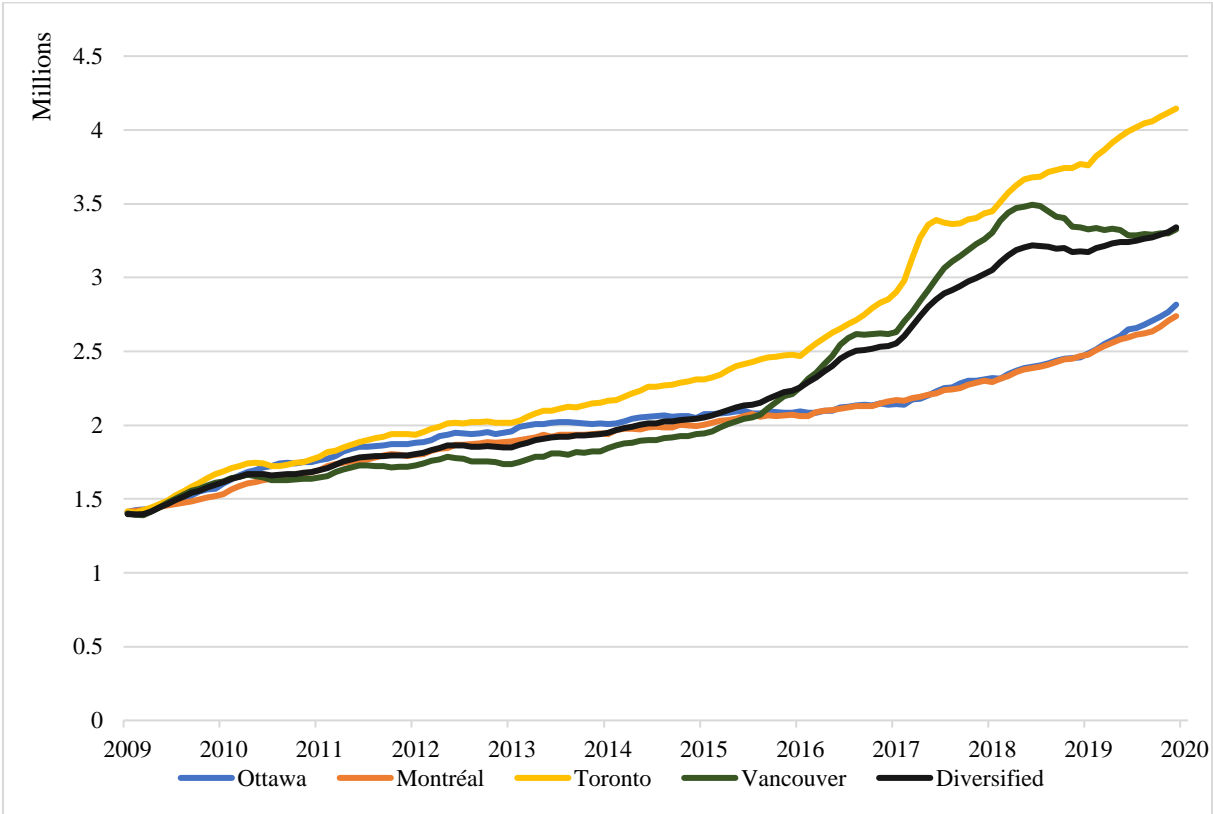
Table 6. Descriptive statistics of the levered apartment portfolios, 2009-2019

	Return	Volatility	Adjusted volatility	Sharpe ratio
Levered portfolios				
Ottawa	7,75%	4,99%	17,04%	0,46
Montreal	7,29%	2,66%	9,09%	0,80
Toronto	12,35%	6,21%	21,20%	0,58
Vancouver	9,66%	10,10%	34,45%	0,28
Diversified	9,82%	6,25%	21,31%	0,46

5.2. REITs portfolio

This section examines the performance of the REITs portfolios. Figure 5 displays the evolution of two REITs portfolios on the post-correction period (2009-2019). As stated before, the portfolios are built like indexes, with rebalancing periods of a quarter and a year. The evolution of the S&P/TSX is also on the graph to help the reader gauge the profitability of the portfolios. The underperformance of the annually rebalanced portfolio is clear with this figure. Table 7 allows for a closer look at the differences between the two portfolios.

Figure 5. Evolution of an investment of $1,000,000 in the residential REITs portfolios, 2009-2019
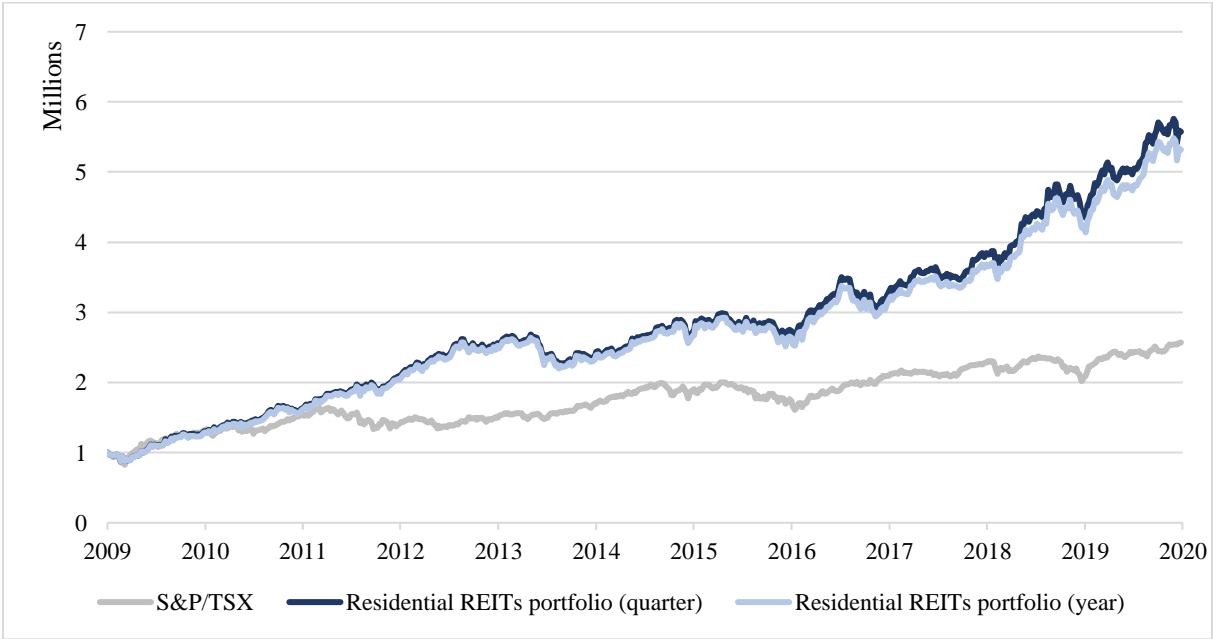
Note: (quarter) and (year) indicate the rebalancing periods.

Table 7. Descriptive statistics of the residential REITs portfolios, 2009-2019

	Return	Volatility	Sharpe ratio
A. Performance 2004-2006			
Residential REIT portfolio (quarter)	28,09%	14,43%	1,9463
Residential REIT portfolio (year)	27,44%	14,41%	1,9048
B. Performance 2007-2008			
Residential REIT portfolio (quarter)	-13,06%	28,84%	-0,4529
Residential REIT portfolio (year)	-13,86%	28,67%	-0,4835
B. Performance 2009-2019			
Residential REIT portfolio (quarter)	16,91%	13,66%	1,2382
Residential REIT portfolio (year)	16,41%	13,70%	1,1980

The quarterly rebalanced portfolio displays higher return and lower volatility. For the rest of this paper, the quarterly rebalanced portfolio will represent the REITs investment.

Table 7 exhibit the strong risk-return profiles of both portfolios for the main period. The residential REITs sector throve from 2009 to 2019. However, the table also displays the performance of the portfolio in both the pre-correction and correction periods. The pre-correction period had the strongest growth out of the 3 periods (figure 6). The REITs sector displays substantial returns in both the pre and post-correction periods. But the results for the correction period are not as conclusive. Figure 7 illustrates the impact of the subprime crisis on the performance of the portfolio.

Figure 6. Evolution of an investment of $1,000,000 in the residential REITs portfolios, 2004-2007
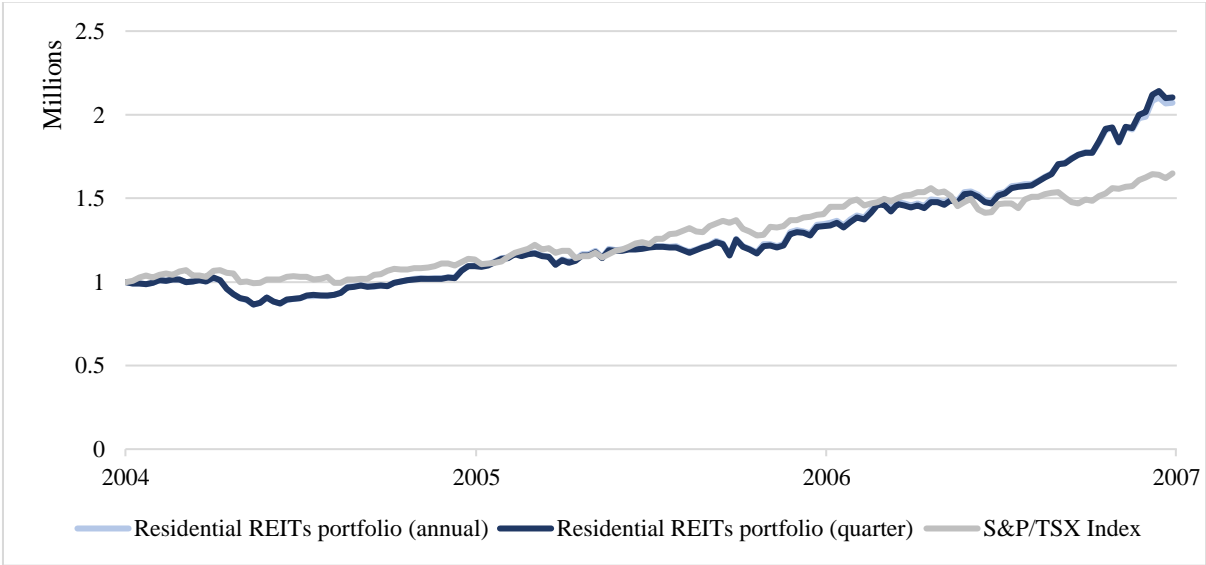
Figure 7. Evolution of an investment of $1,000,000 in the residential REITs portfolios, 2007-2008
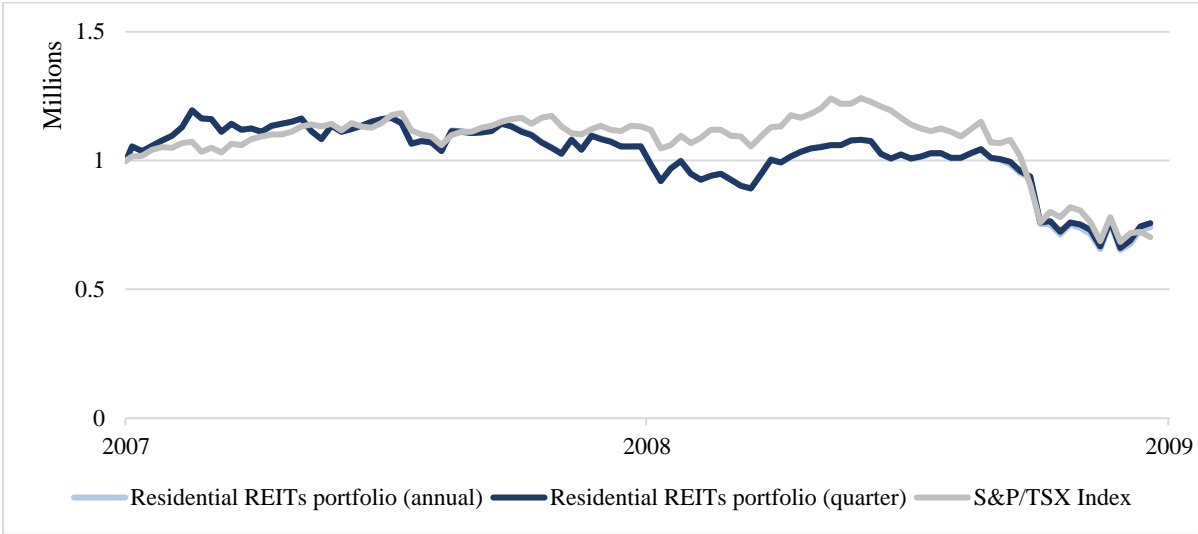
The residential REIT sector plummeted during the subprime crisis, with a return of -28,36%, in 2008, for the quarterly rebalanced portfolio (table 8). In addition, the volatility was at a historical high at 36,83%. This volatility is more than 2 twice as important as the average volatility the 3 years leading to the crisis. The 4 years after 2008, the sector had a strong performance with 26,51% of average return. While the sector benefitted from the post-correction rebound, its performance prior to the correction was even more important, with 57,83% in return in 2006. Even if we consider the returns of 2009 to 2012 to be abnormal, the 7 years following 2012 had an average annual return of 12,29%, which exceeds the average return of real estate investments (i.e. apartment portfolios).

Overall, the sector displayed solid Sharpe ratios during the pre and post-correction periods. And while the returns during the correction period are not as attractive, the sector still outperformed the S&P/TSX index.

Table 8. Annual return and volatility of the residential REITs portfolios, 2004-2019

	Residential REIT portfolio (quarter)		Residential REIT portfolio (year)	
	Return	Volatility	Return	Volatility
A. Pre-correction period				
2004	9,52%	12,24%	9,84%	12,21%
2005	21,59%	16,38%	22,38%	16,74%
2006	57,83%	14,68%	53,99%	14,27%
B. Correction period				
2007	0,86%	20,86%	0,96%	20,66%
2008	-28,36%	36,83%	-29,74%	36,68%
C. Post-correction period				
2009	29,63%	20,43%	27,45%	20,44%
2010	26,01%	13,60%	26,18%	13,57%
2011	27,15%	14,03%	26,96%	14,05%
2012	23,26%	10,88%	23,47%	10,96%
2013	-7,40%	12,76%	-7,78%	13,19%
2014	14,42%	10,49%	14,09%	10,51%
2015	1,49%	13,15%	0,23%	13,32%
2016	19,65%	15,64%	19,45%	15,71%
2017	16,78%	8,67%	15,96%	8,19%
2018	15,33%	15,14%	14,69%	15,29%
2019	25,74%	12,71%	25,97%	12,52%

5.3. Apartments portfolios vs REITs portfolio

5.3.1. REITs vs unlevered portfolios

The difference in profitability between the two-investment means (apartment portfolio and REITs portfolios) is clear for the post-correction period. Figure 8 displays the outperformance of the REITs portfolio.

Figure 8. Evolution of the apartment and residential REITs portfolios, 2009-2019
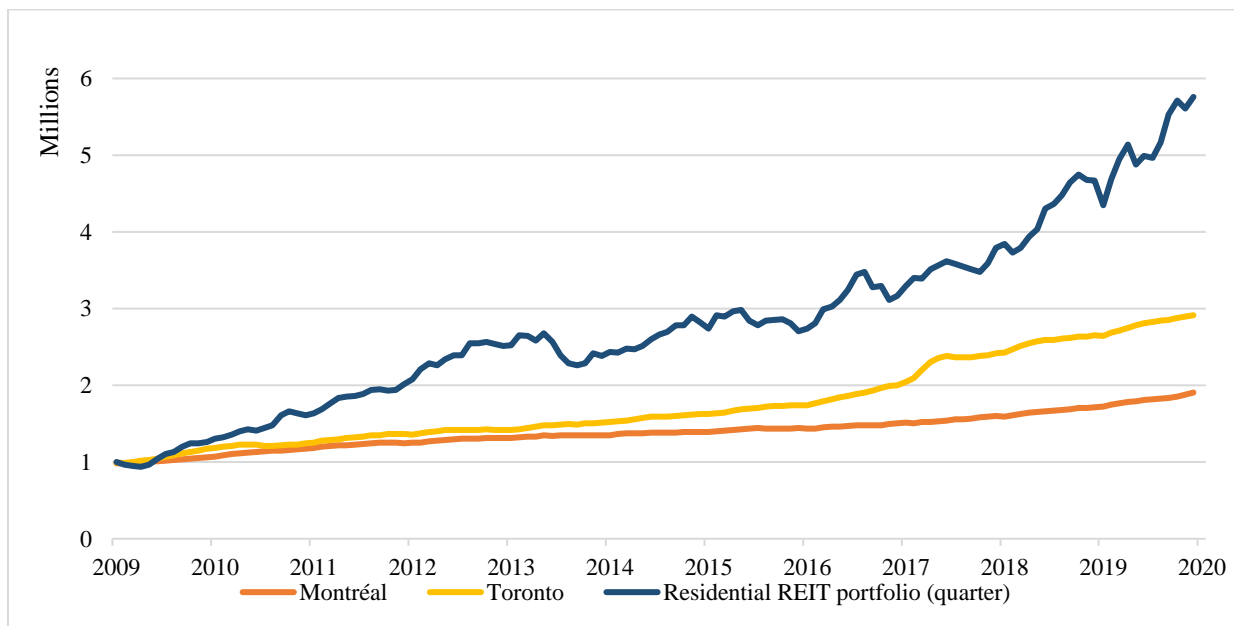
It is apparent that the REITs portfolios outperformed every apartment portfolio (Montréal and Toronto being respectively the worst and best performing portfolios). The residential real estate securities portfolios earned more than twice what the Toronto portfolios earned and more than 4 times what the Montréal portfolio earned. While the graph shows a lot of movement of the REITs portfolios compared to the two other portfolios, it should be kept in mind that this graph displays the unadjusted volatility of the apartments portfolios.

When comparing the adjusted volatility of the apartments to the REITs (tables 4 and 7) the security portfolio has a lower volatility (13,66%) than all the real asset portfolios except for Montréal (9,09%). The Sharpe ratios are compelling proof of the superiority of the REITs portfolio, with 1,24 against 0,58 for Toronto (most profitable portfolio), 0,80 for Montréal (less volatile portfolio) or 0,46 for the diversified portfolio.

Figure 9 offers a year-by-year comparison of the two investment means. Out of the 11 years of the post-correction period, the REITs portfolio was outperformed on only 3 occasions, and by only few apartment portfolios.

Figure 9. Annual returns of the apartment and residential REITs portfolios, 2009-2019
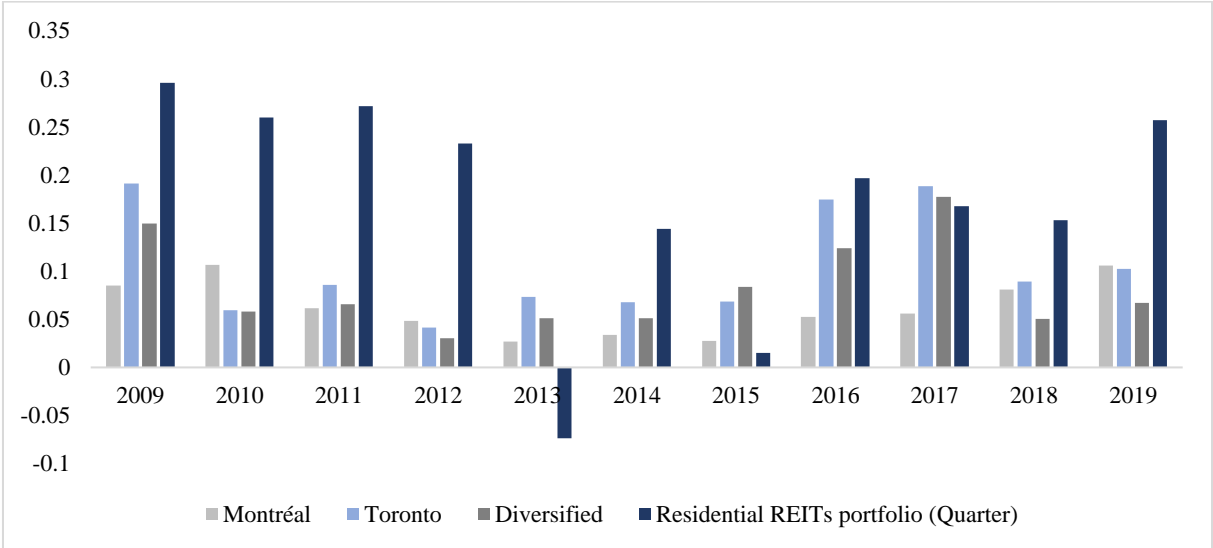
Table 9. Correlation of the portfolios, 2009-2019

	REITs (Q)	REITs (Y)	OT	MTL	TO	VC	DIVER
REITs (Q)							
REITs (Y)	0,998						
OT	0,155	0,160					
MTL	0,107	0,110	0,496				
TO	0,217	0,211	0,220	0,252			
VC	0,148	0,140	0,105	-0,011	0,504		
DIVER	0,222	0,216	0,421	0,314	0,788	0,870	

The correlation between the apartment portfolios and REITs portfolios are low (table 9) and raises the question: To what extent do REITs returns are driven by real estate returns? To correctly answer this question, one should look at the localization of the apartments owned by every REITs on the portfolios and identify the rate of return of each of these localizations. This way, regression and study on the co-movement could be conducted.

Interestingly, the correlation between cities are negligible in some cases. For instance, Vancouver's apartment returns have low correlation with Ottawa's return and even negative correlation with Montréal. This illustrates the extent to which the real estate market is heterogenous. Also, the diversified portfolio of apartments displays the biggest correlation with

the REITs portfolios. This result is intuitive, as a majority of residential REITs are geographically diversified. Thus, the most diversified portfolios should indeed be the one with the biggest correlation with REITs. While localization plays an important role in the co-movement of REITs and real estate market, the type of units should have an impact as well. In the portfolios of apartments, the 3 types are studios, 1-bedroom and 2-bedroom apartments and the units owned by residential REITs could range from single-family house to 5-bedroom apartments. Undoubtedly, single-family homes and studio apartments are driven by different variables. Thus, to effectively study the co-movement of REITs and real estate, the nature of the units and their localization should be accounted for.

Overall, it is clear that the REITs portfolios significantly outperformed every apartment portfolio during the post-correction period (2009-2019). The results for the pre-correction period are similar. Figure 10 shows the evolution of the residential REITs investment against the evolution of the best and worst performing apartment portfolios from 2004 to 2006. While the apartment portfolios display steady growth throughout the 3 years, the residential REITs sector experienced higher volatility and returns. At the end of the 3 years, the REITs portfolio value was 2.016 million compared to 1.523 million for the best performing apartment portfolio (before taxes).

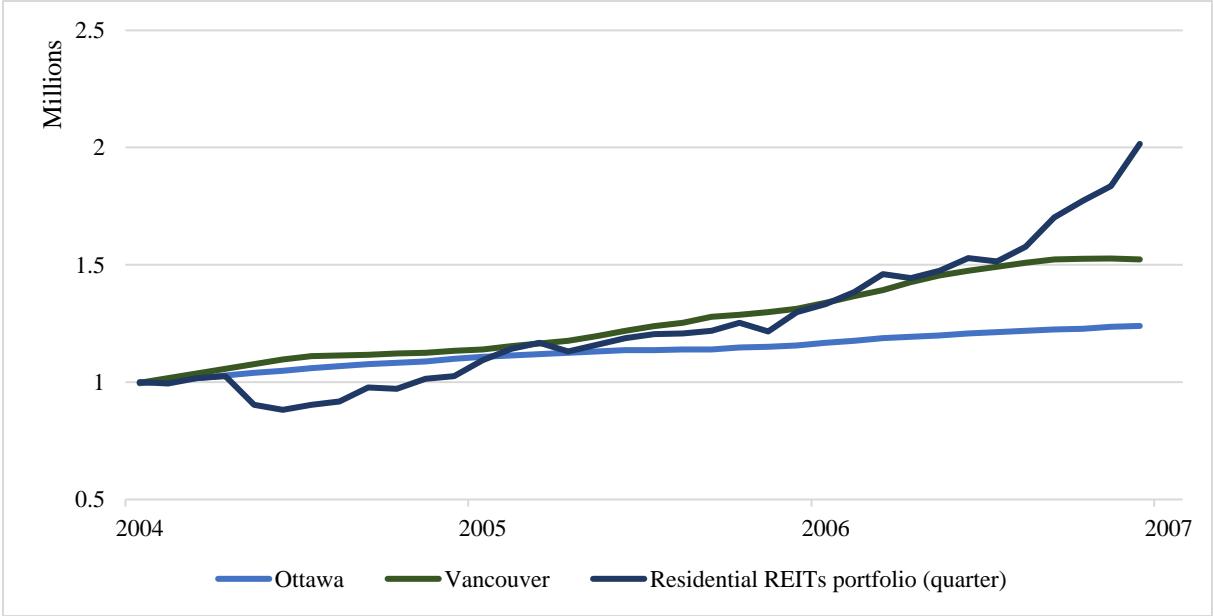Figure 10. Evolution of the apartment and residential REITs portfolios, 2004-2006

In the correction period, the REITs portfolio generated significantly lower returns than the apartment portfolios (Figure 11). The residential REITs sector seems to have exacerbated reaction to both positive and negative shocks compared to real estate.

Figure 11. Evolution of the apartment and residential REITs portfolios, 2007-2008
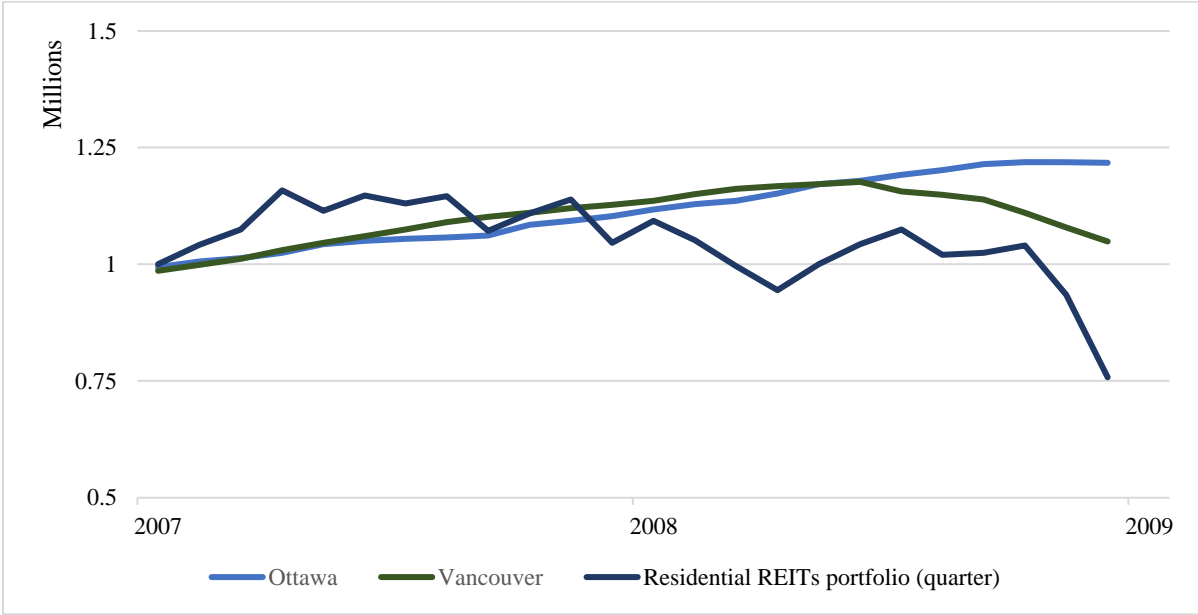
Again, the volatility observed for the two apartments portfolios are unadjusted and thus not fully representative of the real risk. Nevertheless, the REITs portfolio display high volatility and negative return on two consecutive years (2007-2008). In this correction period, the two investment vehicles appear fundamentally different: on one side there is the real assets with resilient returns and low risk and the highly volatile REITs. The overall results are clear, every apartment portfolio outperformed the residential REITs portfolio in the correction period, with higher returns and lower volatility.

The correlation table for the correction period (table 10) shows that the correction increased the correlation of real estate and REITs. This increase in correlation is likely due to the negative effect of the subprime correction on the economy as a whole, rather than just an increase between real estate and residential REITs.

Table 10. Correlation of the portfolios, 2007-2008

	REITs (Q)	REITs (Y)	OT	MTL	TO	VC	DIVER
REITs (Q)							
REITs (Y)	0,9998						
OT	0,4107	0,4171					
MTL	0,4465	0,4476	0,3938				
TO	0,4607	0,4703	0,4331	0,5835			
VC	0,4293	0,4405	0,4061	0,3620	0,8149		
DIVER	0,4985	0,5096	0,5626	0,5145	0,8980	0,9687	

In conclusion, in both the pre and post-correction periods, the residential REITs portfolio is significantly more profitable than the apartments portfolios. And during the correction, the REITs displays stock-like behaviour, experiencing a major decline in value, while the more resilient apartment portfolios continue to have positive returns (except for Vancouver in 2008). Ultimately, the apartments are safer and more profitable in this correction period.

5.3.2. REITs vs Levered apartments

To correctly compare both investment vehicle, it is necessary to reproduce the debt levels of REITs to counter the leverage effects in the returns of the REITs portfolio. The residential REITs sector has an average debt level of 41%. In the real assets portfolio case, it translates into a loan of $410'000. Figure 12 displays the evolution of both levered portfolios (before the repayment of the loan) and the REITs portfolios in the post-correction period.

Figure 12. Evolution of the levered apartment and residential REITs portfolios, 2009-2019
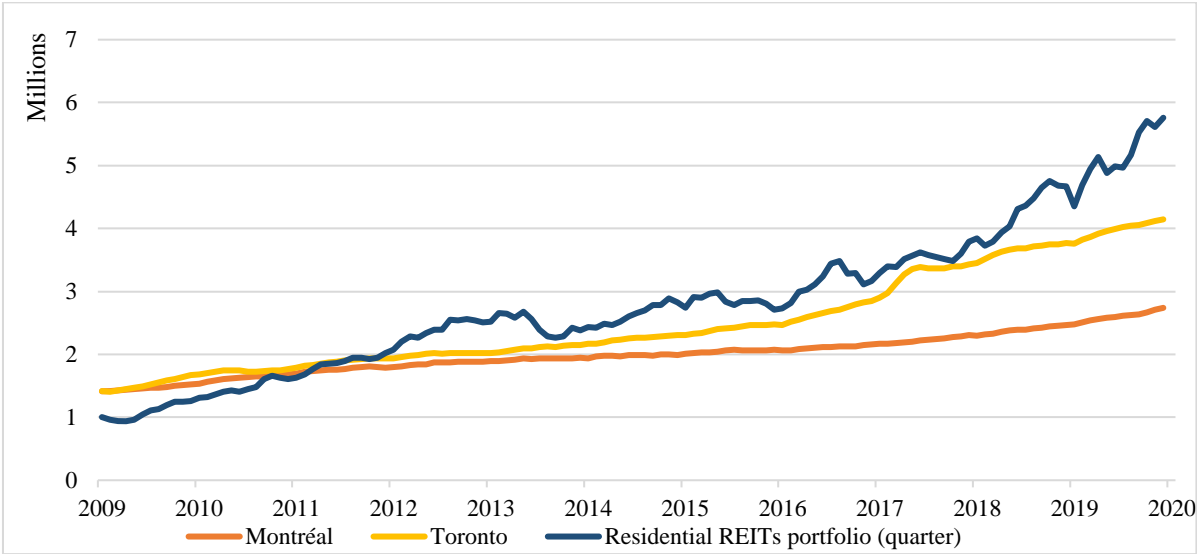
Even without the loan repayments, the apartment portfolios still underperform the REITs portfolio.

Figure 13. Annual returns of the apartment and REITs portfolios, 2009-2019
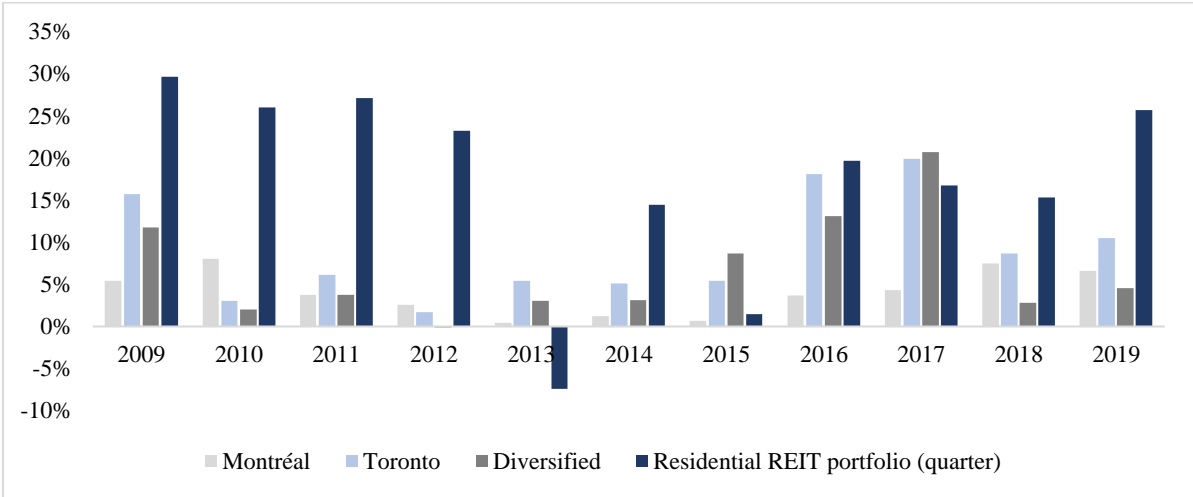
From the annual return of the different portfolios, the same conclusion is drawn; out the 11 years, the REIT investment outperforms the apartment investments 8 times. In the next section, the increase in profitability of the levered portfolios against the unlevered portfolios, before and after taxes, will be studied.

It is clear that the leverage effect cannot fully explain the overperformance of the REITs portfolios. The REITs portfolio remains the most profitable investment vehicle in the post-correction period.

5.3.3. Introduction of taxes in the model

As previously state, the taxes are calculated on the basis that the investors are located in Quebec and has not particular corporation for his apartments.

Table 11 summarizes the amount paid in taxes and the value of the investments after taxes for each period. The assumption here is that the investor is in the second-to-last-tax bracket for federal taxes and in the last bracket for provincial taxes every year except for 2004, 2008 and 2019 (when the portfolios are sold). In 2019, the second-to-last federal taxes bracket in Canada was for the income greater than $150,473 and the last provincial bracket was above $106,555. It is safe to assume that an investor that can invest $1,000,000 cash is earning more than $150,000 including the rental income in this case. Thus, it is assumed that the investor has a yearly income superior to $150,473. When the portfolios are sold, the investor is in the last bracket from both provincial (>$106,555) and federal (>$214,368). In addition, property taxes are included in the tax paid annually during the investment period. It is assumed that the taxes are 1.5% of the value of the portfolios. Thus, when the portfolio is worth $1,000,000 the taxes amount to $15,000 per year. Evidently, the taxes on rental income are computed after the

payment of property taxes. Table 11 summarizes the value of the portfolios before and after taxes.

Table 11. Value of the portfolios before and after taxes, 2009-2019

	Value of the investment on the 31.12.19 before taxes	Taxes paid on the investment period	Value of the investment on the 31.12.19 after taxes
Post-correction period (2009-2019)			
A. Unlevered apartments portfolio			
Ottawa	1,985,494.42	501,384.39	1,484,110.03
Montréal	1,905,836.03	441,929.49	1,463,906.55
Toronto	2,913,273.86	832,000.41	2,081,273.45
Vancouver	2,361,634.48	623,602.38	1,738,032.10
Diversified	2,369,102.41	642,258.15	1,726,844.26
B. Levered apartments portfolio			
Ottawa	2,273,286.67	639,423.61	1,633,863.06
Montréal	2,169,016.89	544,871.14	1,624,145.75
Toronto	3,601,429.06	1,107,434.98	2,493,994.08
Vancouver	2,758,459.13	773,351.26	1,985,107.87
Diversified	2,801,184.72	845,956.15	1,955,228.56
C. Residential REITs portfolio			
REITs portfolio (quarter)	5,578,536.36	1,316,161.34	4,262,375.02

Unsurprisingly, the inclusion of taxes does not change the conclusion for the levered and unlevered portfolios of apartments against the residential REITs portfolios in the post-correction period. The REITs still outperform the real asset investments, with a capital gain, after taxes, of $3,262,375 for the quarterly rebalanced portfolio. The best performing unlevered apartment portfolio (Toronto) has a capital gain of $1,081,273, while its levered equivalent has $1,493,994. The difference in profitability is immense. The use of leverage to invest in private real estate does enhance the profit. The best performing portfolio (Toronto) earned an additional 412,721 dollars thanks to the loan (after taxes and loans repayment). The worst performing portfolio (Montréal) earned an extra 160,239 dollars. On average undertaking a loan increased the capital gain by 33,3% across all the portfolios.

Similarly to the post-correction period, the inclusion of taxes did not change the outcome for the pre-correction and correction period. For the 2004-2006 period, the best-performing investment mean was the REITs portfolios, with a final value of $1,823,793 after taxes

compared to the value of the best performing apartment portfolio (Vancouver) of $1,332,065 after taxes.

Finally, the best preforming investment during the subprime crisis was the portfolio of apartments, more specifically the portfolio in Ottawa, with a value at the end of the 2 years of $1,115,997 after taxes. The REITs portfolio has a value of $755,814.69 after taxes (loss of $244,185.31)

Table 12. Value of the portfolios before and after taxes, 2004-2006

	Value of the investment on the 31.12.06 before taxes	Taxes paid on the investment period	Value of the investment on the 31.12.06 after taxes
Pre-correction period (2004-2006)			
A. Apartments portfolio			
Ottawa	1,239,794.31	117,034.48	1,122,759.83
Montréal	1,295,759.19	126,479.01	1,169,280.18
Toronto	1,266,362.78	126,171.15	1,140,191.63
Vancouver	1,522,689.58	190,624.11	1,332,065.48
Diversified	1,343,395.17	146,884.00	1,196,511.17
B. Residential REITs portfolio			
REITs portfolio (quarter)	2,101,780.93	277,987.52	1,823,793.41

Table 13. Value of the portfolios before and after taxes, 2007-2008

	Value of the investment on the 31.12.08 before taxes	Taxes paid on the investment period	Value of the investment on the 31.12.08 after taxes
Correction period (2007-2008)			
A. Apartments portfolio			
Ottawa	1,217,914.73	101,917.60	1,115,997.12
Montréal	1,186,989.41	87,903.14	1,099,086.27
Toronto	1,188,483.56	94,320.99	1,094,162.58
Vancouver	1,049,182.83	51,794.40	997,388,43
Diversified	1,148,863.16	81,735.59	1,067,127,57
B. Residential REITs portfolio			
REITs portfolio (quarter)	755,814.69	0	755,814,69

## 5.4. How do REITs measure against other investment means?

As mentioned before, studies have found (Chmiel and Rodrigues (2019)) that since 1998 the TSX capped REIT index had a compounded annualized total return of 11,4%, which

outperformed the S&P/TSX index by 4,6%. While US REITs generated lower return on this period, they manage to generate 10,9% of annualized total return (Nareit all equity REITs index) and outperform the S&P500 index 15 out of the last 25 years. Additionally, REITs are renowned for their higher dividend yields due to the particular requirements to qualify as a REIT. Indeed, REITs have to pay 90% of their taxable income as dividends to shareholders. As a result, the Nareit all equity REITs index has a dividend yield more than twice as important as the S&P 500 (4% against 1,9%).

While informative, these numbers are on indexes regrouping every class of equity REITs. In this paper, the class of interest is the residential REITs.

Figure 14 displays the evolution of an investment in the residential REITs portfolio, in the S&P500, in the S&P/TSX and in the Nareit All equity REITs for the post-correction period.

Figure 14. Evolution of an investment in the REITs portfolio and in indexes, 2009-2019
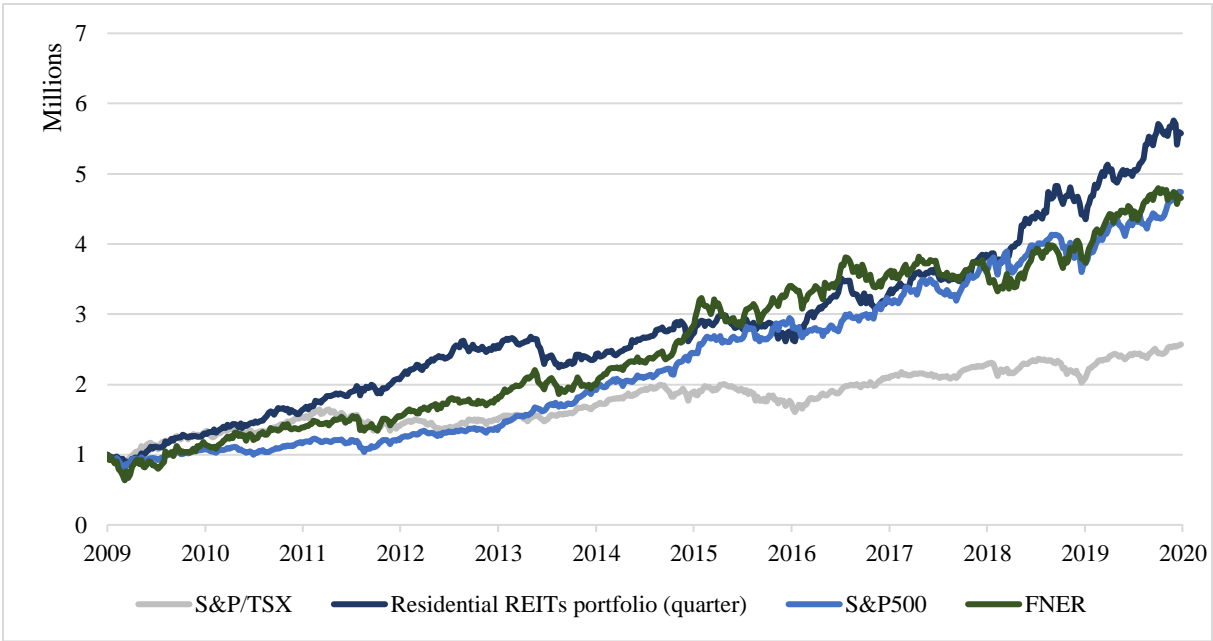
The results on the Nareit All Equity REITs are confirmed. For the most part of 11 years, the index outperformed the S&P500. Additionally, the index outperformed the residential REITs portfolio for two years, but overall the portfolio displays the strongest performance over the 11 years. While indexes are informative on specific sectors of the stock market, comparing the portfolios with securities in which traders can invest money is essential. To do so, ETFs on indexes and ETFs on real estate are used. More specifically, 4 ETFs on Canadian real estate, 4 ETFs on American real estate, an ETF on the S&P500 and an ETF on the S&P/TSX 60 Index. The IShares SPTSX ETF (XIU) and the IShares S&P500 ETF (XSP) are used to reproduce, respectively, the S&P/TSX 60 and the S&P500 indexes. In the Canadian real estate sector, the

IShares S&P/TSX Capped REIT (XRE) index tracks the S&P/TSX capped REIT index. The index represents every REIT class. As of January 2020, the ETF contained only 27,04% of residential REITs. Additionally, the CI First Asset Canadian REIT ETF (RIT), the BMO Equal Weight REITs ETF (ZRE) and the Vanguard FTSE Canadian Capped REIT ETF (VRE) are included for the comparison. The ZRE and VRE ETFs replicate, respectively, the Solactive Equal Weight Canada REIT Index (with 22,8% of residential REITs as of November 30, 2019), and the FTSE Canada All Cap Real Estate Capped 25% index (with 21,6% residential REITs as of March 31, 2020).

Figure 15. Evolution of an investment in the REITs portfolio and in Canadian ETFs, 2009-2019
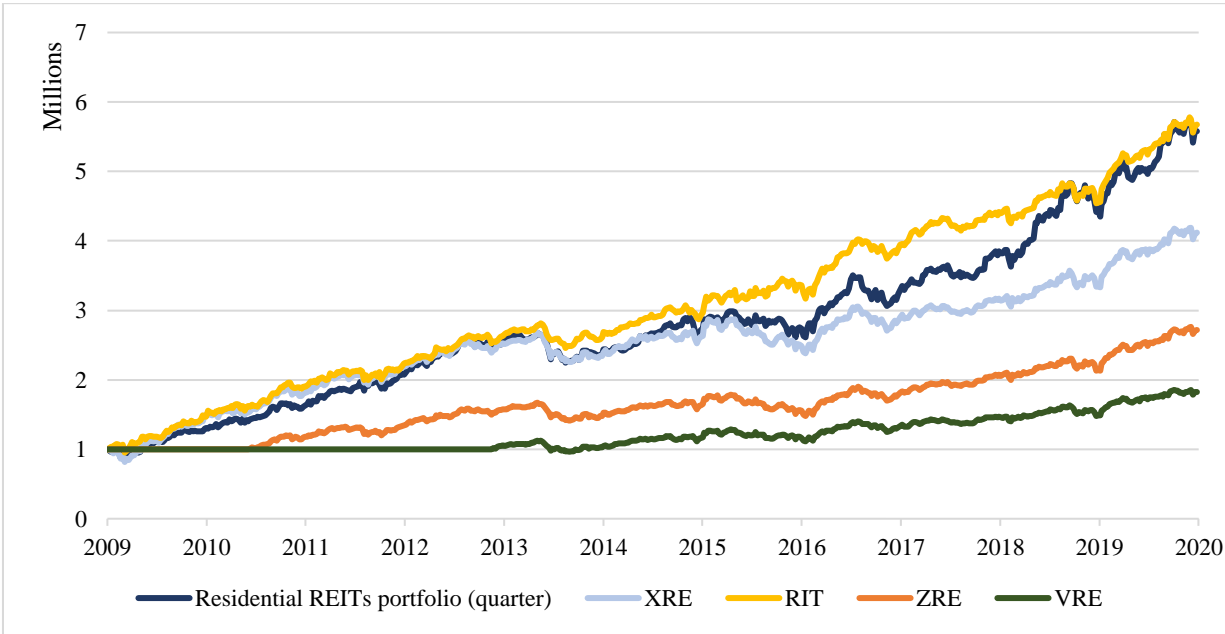

Figure 15 illustrates the performance of the ETFs against the portfolio. The only ETF that outperforms the portfolio is the RIT ETF. Let's note that the ZRE and VRE ETFs started later than January 1, 2009 (beginning of the main period), which is problematic for the comparison. To solve this issue, table 14 displays the annual return of each the 10 ETFs and of the portfolio of REITs.

Table 14. Annual returns of the residential REITs portfolio and Canadian ETFs, 2009-2019

	Residential REITs portfolio	XRE	RIT	ZRE	VRE
Post-correction					
2009	29,63%	48,79%	46,85%		
2010	26,01%	21,92%	29,21%		
2011	27,15%	20,82%	17,80%	13,87%	
2012	23,26%	15,31%	17,86%	17,11%	
2013	-7,40%	-7,34%	-0,78%	-5,67%	-2,38%
2014	14,42%	12,04%	12,00%	10,51%	12,80%
2015	1,49%	-4,42%	15,11%	-4,42%	1,47%
2016	19,65%	15,67%	17,06%	16,01%	13,31%
2017	16,78%	9,26%	11,87%	14,36%	10,05%
2018	15,33%	5,28%	3,14%	3,01%	1,54%
2019	25,74%	23,32%	24,58%	27,26%	22,46%

The residential REITs portfolio outperforms the ZRE ETF every year since 2011, except for 2013 and 2019. Similarly, the VRE ETF underperforms the residential REITs portfolio every year except for 2013. Up to this point, the only security outperforming the portfolio in this period is the RIT ETF.

On the American side, the 4 ETFs are the IShares Core US REIT ETF (USRT)(18,99% residential REITs), following the FTSE Nareit Equity REITs index, the Vanguard Real Estate Index Fund (VNQ) (14,5% of residential REITs), tracking the MSCI US Investable real estate market 25/50 index, the Schwab US REIT ETF (SCHH) (26,63% residential REITs), following the Dow Jones US Select REIT Index and the IShares US real estate ETF (IYR) (14,18% of residential REITs), tracking the Dow Jones US Real estate Index.

Figure 16 displays the evolution of the American ETFs.

Figure 16. Evolution of an investment in the REITs portfolio and in American ETFs, 2009-2019
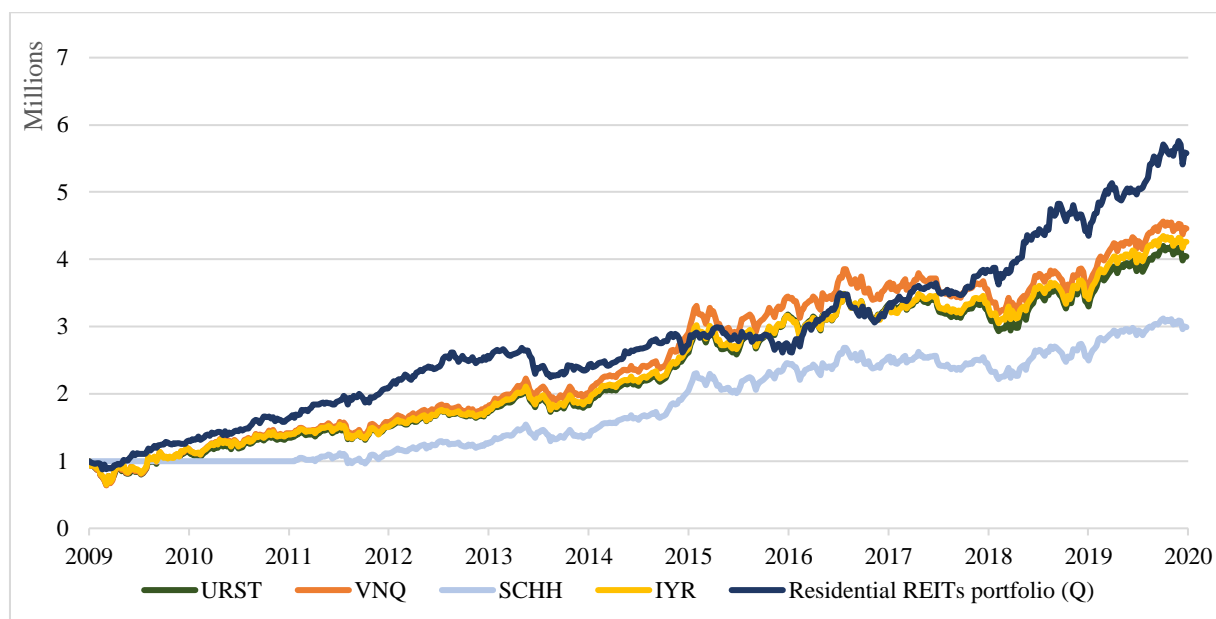
The results are clear, the residential REITs portfolio has the highest value at the end of the period. But again, the ETF SCHH starts in 2011. Table 15 allows for an in-depth comparison of annual returns.

Table 15. Annual returns of the residential REITs portfolio and American ETFs, 2009-2019

	Residential REITs portfolio	USRT	VNQ	SCHH	IYR
Main period					
2009	29,63%	16,08%	19,83%		19,96%
2010	26,01%	16,46%	18,46%		16,49%
2011	27,15%	11,62%	11,05%		7,89%
2012	23,26%	13,29%	13,91%	13,27%	14,63%
2013	-7,40%	7,34%	11,67%	9,90%	9,96%
2014	14,42%	41,21%	42,75%	45,01%	39,09%
2015	1,49%	21,96%	20,11%	22,26%	19,54%
2016	19,65%	4,95%	5,86%	3,81%	4,03%
2017	16,78%	-1,94%	-2,29%	-3,44%	1,83%
2018	15,33%	3,58%	2,03%	3,88%	3,86%
2019	25,74%	19,88%	22,86%	17,22%	22,45%

The SCHH ETF displayed strong returns from 2012 to 2015, outperforming the residential REITs portfolio 4 out of the 8 years. But overall, none of the American ETF on real estate can compete with the returns of the residential REITs portfolio.

Table 16. Descriptive statistics of the residential REITs portfolio and all the securities, 2004-2019

	Return	Volatility	Sharpe ratio
A. Performance 2004-2006			
Canadian securities			
Residential REIT portfolio (quarter)	28,09%	14,43%	1,9463
XRE	20,40%	14,25%	1,4315
RIT	15,62%	11,05%	1,4137
SPTSX	18,14%	11,23%	1,6161
XIU	18,81%	11,60%	1,6216
XBB	6,20%	4,02%	1,5420
American securities			
FNER	16,84%	16,36%	1,0298
IYR	20,16%	16,51%	1,2207
VNQ	16,66%	13,81%	1,2067
S&P500	6,89%	11,29%	0,6107
XSP	6,89%	11,15%	0,6178
B. Performance 2007-2008			
Canadian securities			
Residential REIT portfolio (quarter)	-13,06%	28,84%	-0,4529
XRE	-24,47%	28,68%	-0,8533
RIT	-26,81%	30,96%	-0,8658
SPTSX	-16,20%	24,26%	-0,6675
XIU	-14,61%	22,73%	-0,6430
XBB	4,01%	4,07%	0,9847
XCB	0,23%	4,26%	0,0530
American securities			
FNER	-26,94%	35,08%	-0,7678
IYR	-29,29%	33,74%	-0,8681
USRT	-27,50%	36,05%	-0,7629
VNQ	-26,65%	35,00%	-0,7614
S&P500	-18,05%	19,55%	-0,9233
XSP	-22,80%	25,14%	-0,9070
B. Performance 2009-2019			
Canadian securities			
Residential REIT portfolio (quarter)	16,91%	13,66%	1,2382
XRE	13,72%	12,95%	1,0597
RIT	17,09%	11,21%	1,5245
ZRE	11,76%	10,10%	1,1651
VRE	8,99%	8,55%	1,0517
SPTSX	8,96%	13,66%	0,6561
XIU	8,65%	13,25%	0,6531
XBB	4,24%	4,04%	1,0491
XCB	5,32%	3,66%	1,4523
American securities			
FNER	15,01%	20,49%	0,7327
USRT	13,53%	19,66%	0,6882
VNQ	14,55%	20,57%	0,7076
SCHH	14,68%	13,53%	1,0854

IYR	14,07%	19,41%	0,7252
S&P500	15,19%	13,25%	1,1467
XSP	13,19%	15,18%	0,8689
XIG	5,14%	5,12%	1,0042
XHY	5,65%	7,00%	0,8076

In the main period, the only security displaying a better risk return profile that the portfolio is the RIT ETF (Canadian REITs), with a Sharpe ratio of 1,52 against the 1,24 of the portfolios. Table 16 also illustrates the difference between the 3 periods. Unsurprisingly, every ETFs on American real estate display negative return and high volatility during the correction period. In Canada, the real estate ETFs also had negative returns during this tumultuous period. The only asset that earned money during this period is bond. With Canadian bonds (XBB) and Canadian corporate bonds (XCB) returning respectively 4,01% and 0,23% between 2007 and 2008. The Canadian bonds were the perfect shelter for investors in the financial meltdown. But one could argue that corporate bonds are not as interesting for a flight-to-safety, but the XCB ETF still managed to get positive returns.

Thus, in the pre and post-correction periods, the residential REITs portfolio displayed the best and second best (after the RIT ETF) Sharpe ratio, outperforming every Canadian and American securities. In the correction period, safer investments such as bonds were the most attractive. Even though the Sharpe ratio of the residential REITs portfolios was negative, it was the best risk-return ratio after the bonds.

Table 17 displays the value of the investments in 10 ETFs and the REITs portfolio, in the three periods before and taxes.

After reviewing apartment portfolios, REITs portfolios and ETFs, the conclusion is unambiguous: REITs outperform private real estate investment in non-crisis settings. In both the pre and post-correction periods, the REITs portfolios significantly outperformed the apartment portfolios, earning at least twice as much. Additionally, the residential REITs portfolio performance also exceeded every ETFs (except for the RIT ETF) in both periods, illustrating the profitability of residential equity REITs. However, the private real estate investments were significantly more profitable and safer in the correction period. The apartment portfolios exhibited strong risk-return profile even in the midst of the subprime crisis. The reader should note that the correction period (2007-2008) represents some of the worst times to invest in the stock market. An investor that invested in the stock market in January 2007 (high point in the stock market) and withdraw his investment in December 2008 (low point in the stock market) would have made a sever mistake. It is well known that post-correction returns are attractive. In the REITs portfolio's case if the investment was held for 2 years after 2008,

the investor would have earned 29,63% and 26,01% in those 2 years. Figure 17 displays the evolution of the REITs portfolio and the best and worst performing apartment portfolios from 2004 to 2019. At the end of the 2008, the value of the apartment and the REITs portfolios were similar, around 1.5 million.

Table 17. Value of the investments before and after taxes, 2004-2019

	Value of the investment at the end of the period before taxes	Taxes Paid	Value of the investment at the end of the period after taxes
A. Pre-correction period			
Canadian securities			
REITs portfolio (quarter)	2,101,780.9	277,987.5	1,823,793.4
XRE	1,745,466.3	183,564.1	1,561,902.1
RIT	1,545,498.4	130,572.7	1,414,925.8
XIU	1,676,922.4	165,400.0	1,511,522.4
American securities			
IYR	1,734,734.3	180,720.2	1,554,014.2
VNQ	1,587,756.9	141,771.1	1,445,985.7
XSP	1,221,327.4	446,67.3	1,176,660.1
B. Correction period			
Canadian securities			
REITs portfolio (quarter)	755,814.7	0	755,814.7
XRE	570,493.5	0	570,493.5
RIT	535,714.8	0	535,714.8
XIU	729,080.5	0	729,080.5
American securities			
IYR	500,044.3	0	500,044.3
USRT	525,613.1	0	525,613.1
VNQ	538,025.8	0	538,025.8
XSP	595,915.0	0	595,915.0
C. Post-correction period			
Canadian securities			
REITs portfolio (quarter)	5,578,536.4	1,316,161.3	4,262,375.0
XRE	4,115,352.3	886,351.0	3,229,001.3
RIT	5,670,203.8	1,343,088.7	4,327,115.1
ZRE	2,720,564.0	476,632.0	2,243,932.1
VRE	1,826,692.8	214,057.3	1,612,635.5
XIU	2,491,456.3	409,331.6	2,082,124.7
American securities			
USRT	4,038,339.1	863,728.4	3,174,610.7
VNQ	4,457,706.9	986,917.7	3,470,789.2
SCHH	2,992,012.2	556,369.9	2,435,642.3
IYR	4,256,251.3	927,740.1	3,328,511.2
XSP	3,908,372.1	825,550.6	3,082,821.5

Evidently, the crisis had a severe effect on the, otherwise, more profitable REITs portfolio. Nonetheless, at the end of the first 5 years of the investment period, the investments were comparable in value. But the variance of the REITs portfolio was far superior, with the extreme fluctuations during the subprime crisis. Then, the year 2009 kick-started the constant outperformance of the REITs portfolios. Indeed, at the end of 2019, the REITs portfolio is worth 8.47 million dollars, thus gaining 7.47 million since 2004. On the other hand, the best performing apartment portfolio (in Toronto) was valued at 3.88 million, gaining 2.88 million in 16 years. These results reflect the two different risk-return profile of both investment. The readers should keep in mind that stocks benefit from compounded returns. Investing $1,000 in the stock market for 10 years, with a 10% annual return, would lead to a capital gain of $1,594 over the period. On the other hand, investing $1,000 in an investment yielding the same return (10%) but without reinvesting the gains would lead to a capital gain of $1,000. This is what we are observing here. Hence, in addition to the superior returns, the REITs portfolio, by nature, is more profitable. This important difference lead to a 4.59 million disparity between the REITs portfolios and the best performing apartment portfolio.

Figure 17. Evolution of the apartment and the REITs portfolios, 2004-2019
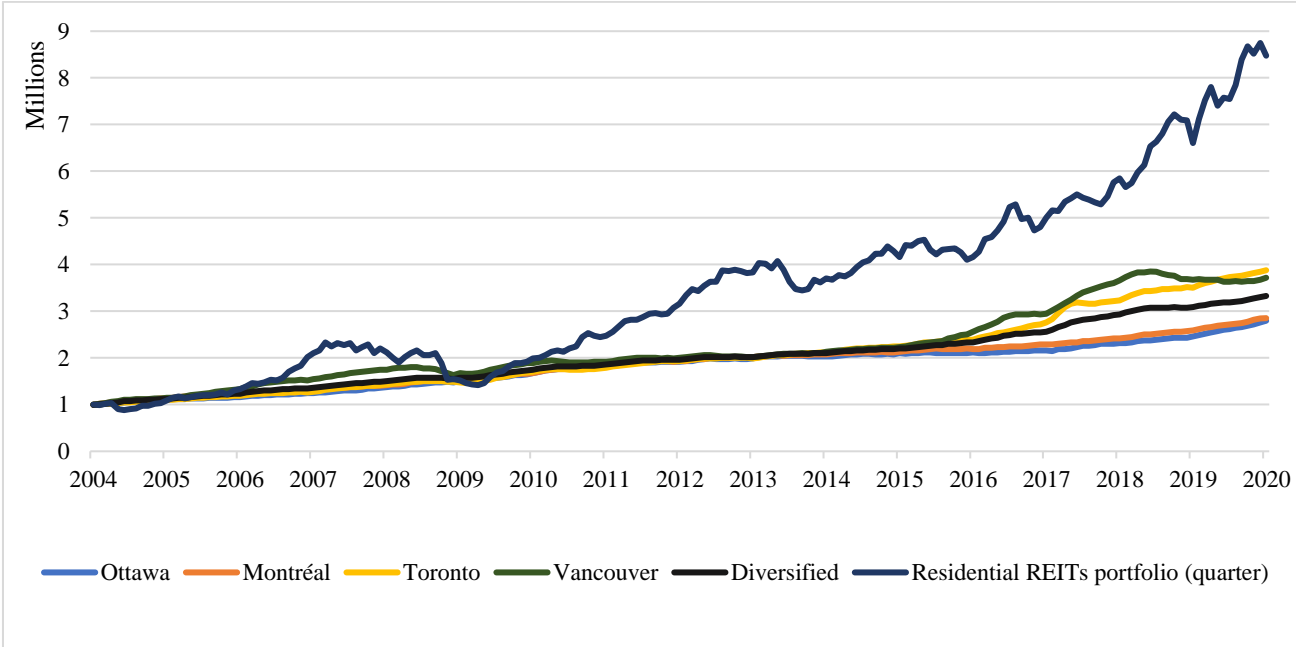
6. Links with existing literature

6.1. Why real assets ?

6.1.1. REITs investment for institutions

The challenges for institutional investors are often different than those of retail investors. More specifically, the pressure to invest and the liquidity constraint are two of the major concerns of institutional investors. Ciochetti, Craft and Shiling (2002) studied the preferences of institutional investors for REITs. They created a model that maximizes the surplus return (defined as the asset minus liabilities) under risk and liquidity constraints. An implication of the model is that liquidity constrained institutions will choose REITs rather than illiquid real estate assets. Furthermore, they found some evidence that institutions tend to go with greater market capitalization and liquidity REITs. Devos et al. (2013) found evidence of the flight to quality theory in institutional investments in REITs. Thus, institutional investors, after the financial crisis of 2008, moved toward bigger and more mature REITs. The authors also discovered the changes in institutional ownership of REITs during the crisis. By studying three periods, before, during and after the crisis, they determined that institutional investors' ownership in REITs peaked in early 2008. Subsequently, their ownership level dropped as the crisis unfolded. It's only after the downturn that institutional ownership rebounded. In similar fashion Das, Freybote and Marcato (2015) studied two theories in both the securitized and unsecuritized real estate markets. They searched for evidence of style investing and flight to liquidity theories. Again, the authors used the 3 distincts periods: before, during and after the subprime crisis. In the pre-crisis period (2002-2006), the dominating theory is the style investing. The theory postulates that the investors are coming in and out of the market based on their sentiments on the underlying private market. Here, the institutional investors are in and out of the real estate market, which includes both securitized (REITs) and unsecuritized (private) real estate. Evidence shows that investors' sentiments in a private real estate have a direct impact on their REITs holding. However, during and after the crisis, the flight to liquidity theory overshadows the style investing theory. The results are clear, institutional investors switched from the illiquid unsecuritized real estate market to the securitized market. Interestingly, the post-crisis period (2010-2012) retained these preferences toward more liquid real estate investments (i.e. REITs).

Overall, liquidity is crucial in the investment strategies of institutions. For the retail investors, the theories are less developed. It has yet to be discovered why retail investors invest more in private real estate than in REITs.

6.1.2. Real assets for retail investors

As mentioned earlier, retail investors invest less in REITs than they do in private real estate. In this case, the purchase of a home does not count as a private real estate investment. Here, the focus is on rental units (i.e. units that are purchased as an investment vehicle). The SCHL estimated, in 2016, that individual investors owned 49,3% of purpose-build rental apartment units, compared to the 39,7% and 7,9% owned by private corporations and REITs. Additionally, the Canadian rental housing index determined that 4,4 million units are rented across Canada. Thus, 2'189'418 are owned by individual investors. Moreover, the average price for an apartment in Canada, as of December 2019, is $480'900 according to the MLS-HPI Index. Hence, the amount invested in private real estate, by individual investors, is 1'050 billion dollars. In comparison, the REITs market value, in December 2019, was 120 billion dollars. And 30% of the market is owned by institutions, leaving 70% or 84 billion dollars to the retail investors. Now considering only the residential REITs space, which accounts for 22% of the market, retail investors had approximately 18,5 billion invested in this asset class. This represents 1,8% of the amount invested in private real estate. Undeniably, retail investors are not fully utilizing REITs as an investment vehicle. Why is the asset class underused in such a way? The novelty and recent growth of REITs can probably explain some of the questions. Indeed, the market capitalization of REITs has been multiplied by more than 7 in the last 15 years but remains a fraction of the Canadian stock market. Other explanations for this phenomenon are yet to be discovered.

It seems that retail investors perceive private real estate as a safe and profitable investments, and more so than the stock market. Judging by the results of the last section of this paper, it is evident that private real estate is more resilient and less variable. But it is also far less profitable than REITs. While research on investors' sentiments have not touched the behaviour of retail investors in the securitized and unsecuritized market, there exist facts that could help understanding the phenomenon. Indeed, it is undeniable that the average investor knows more about private real estate than about stocks. Every adult is confronted to the real estate market in his life, whether he's looking for an apartment to rent or buying a property. On the other hand, the stock market, let alone REITs, is often unknown and perceived as risky. Thus, when

the time comes to invest money, people are drawn to a private real estate. The popular opinion seems to encourage investors to hold "real assets" rather than invest in stocks. In addition, one could argue that researching information on real estate properties is "easier" than for stocks for the average investor. It is easier to assess the quality of a property than the quality of a stock for someone that has no knowledge in either subject. But in reality, the information asymmetry is far superior in the private real estate market than it is in the stock market. One of the biggest upsides of real estate is the ability to use leverage. While investing in real estate requires a substantial amount to start, the access to loans is far easier than for other type of investment. The down payment for a real estate investment is usually 20%, meaning that an investor with $200,000 can undertake a loan for a million dollar. Evidently, the loan repayment would amount to the rental income from the purchased property, but the appreciation of the investment is a non-negligible part of the returns. In this sense, a retail investor could use leverage to invest in real estate and dramatically increase his returns. But this comes at a cost, as the insolvency risk exists and increases with the loan-to-value ratio. Overall, the ability to use leverage in real estate could be one of the explanation for the preference toward unsecuritized real estate of retail investor.

Another potential explanation is the risk associated with both activities. Retail investors might perceive private real estate as safer than stocks. But research on real estate risk has shown that estimating the risk on such investment is difficult. Additionally, the time spent selling the investment at the end of the holding period is often forgotten even though it has a significant impact on the overall risk and return of the investment. This results in severe underestimation of the volatility of unsecuritized real estate. On the contrary, the risk in the stock market is computed easily. Thus, for an uninformed investor, it is easy to judge the stock market as riskier than the private real estate because the risk computed on the stock market is accurate while the risk in a private real estate is underestimated. However, it is true, for residential real estate at least, that the unsecuritized real estate market has been more resilient than the securitized market in times of crisis. The results of the last section during the subprime crisis confirmed it. And so does the next section on the performance of the two investments means during the COVID-19 crisis.

6.2. Portfolios during the COVID-19

The research for this paper has been conducted in the midst of the 2020 pandemic (COVID-19). This health crisis has rapidly evolved in an economic crisis. The stock market is

experiencing a major downturn and historical high volatility. Additionally, the oil war is intensifying, increasing the distress on the market and reducing the investors' confidence to extremely low levels. This section reviews the evolution of both the REITs portfolio and the apartment portfolios' performance in this tumultuous period.

The additional data has been collected from January 1, 2020, to May 1, 2020, for the REITs portfolio and from January 1, 2020, to April 1, 2020, for the apartment portfolios. The hypothesis is that the portfolios are not sold at the end of 2019 but held through the crisis.

The results are clear for the REITs portfolio, the bad market condition leads to -9,20% return in the 5 months following December 2019 (figure 18). Comparatively, the S&P/TSX lost 13,32% during the same period, illustrating the resilience of residential real estate during this crisis. March 2020 marked the REITs portfolio as the worst performance since its inception (2004), with a return of -27,80% (table 18). In comparison, the worst monthly return prior to 2020 was in October of 2008, with a return of -18,90%. Hence, at the beginning of January 2020, the portfolio was worth over 5,57 million, and as of May 1st, the value dropped to 4,98 million dollars. Evidently, the volatility surged in this hectic period. The average volatility of the REITs portfolios in the post-correction period (2009-2019) was 13,66% and the highest volatility during the entire period (2004-2019) was of 36,83% in 2008. In 2020, the volatility was recorded at 50,90%. In comparison, the S&P/TSX had a volatility of 44,63% in the same period.

Figure 18. Evolution of the residential REITs portfolio and the S&P/TSX, 2009-2020
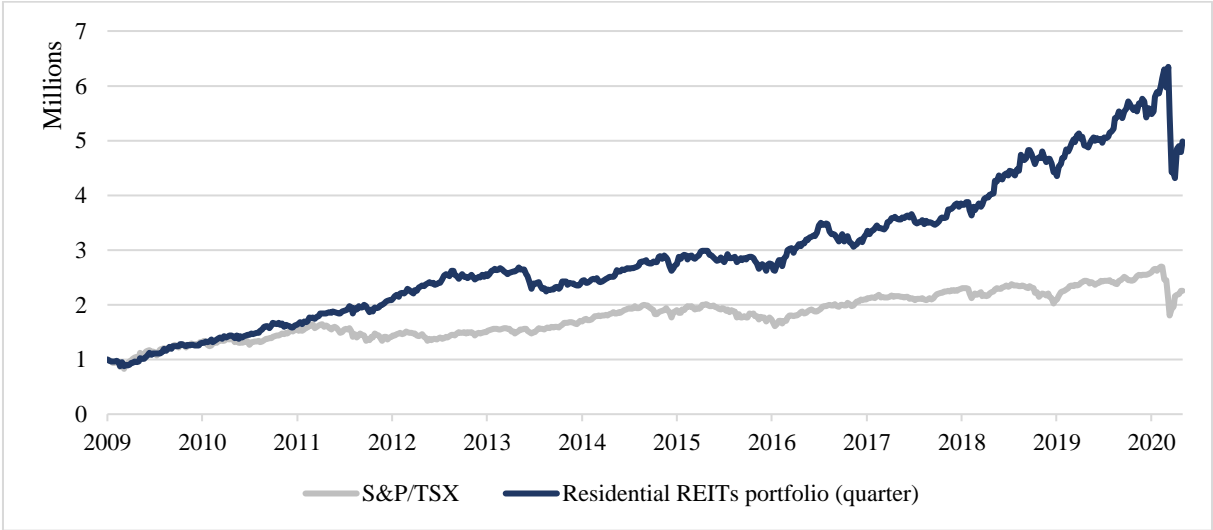
Table 18. Monthly returns of the residential REITs portfolio and the S&P/TSX, 2020

	REITs portfolio (Q)	S&P/TSX index
Performance in 2020		
January	6,87%	2,60%
February	1,86%	-8,16%
March	-27,80%	-19,70%
April	13,21%	14,56%

In the apartment portfolios, the effects of the crisis have yet to be observed. The model used to study the evolution of the apartments is such that the leases are renewed as of January 1st. So the effect on rents are inexistent. However, the MLS HPI is published monthly, and the effect of the corona virus could theoretically be observed. Figure 19 illustrates the evolution of the portfolios on the January 2009 to April 2020 period.

Figure 19. Evolution of the apartment portfolios, 2009-2020
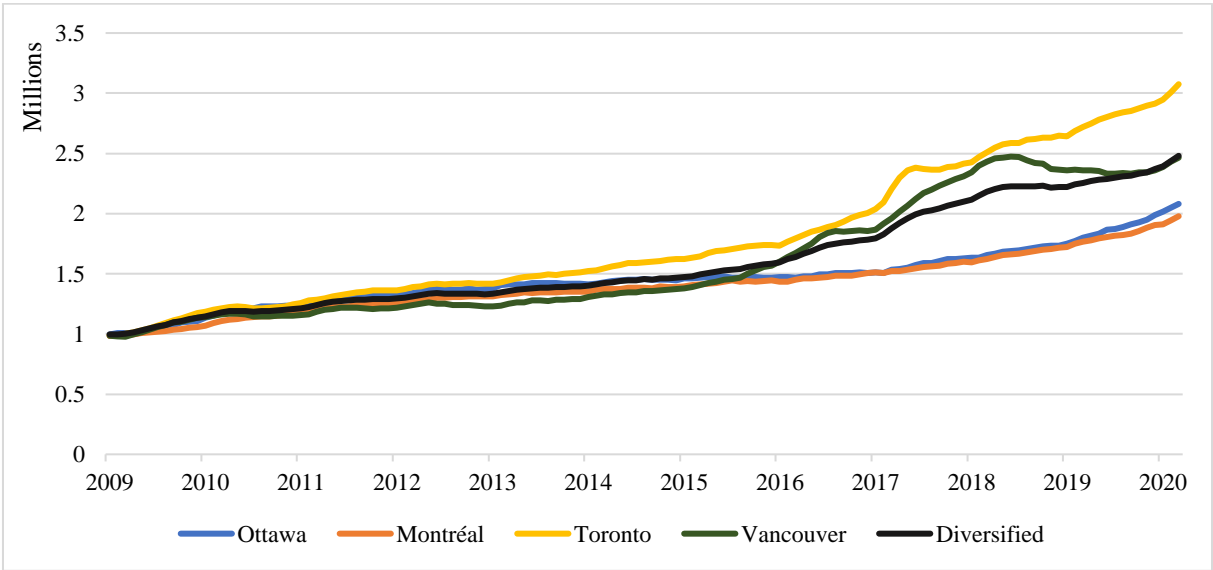
The graph displays the absence of negative return in the month of March. Multiple factors can explain this result. First, the private real estate market is not as responsive to shocks as the stock market is. Secondly, while March marked the beginning of the pandemic in Canada, the duration and severity of the crisis were and still are unknown. Logically, variables such as GDP growth, unemployment or wage growth that drive real estate will be negatively impacted by this pandemic. It is highly likely that the price of real estate will drop in the near future but the decrease in value is hard to forecast. Overall, the effect of this crisis on the apartment portfolios is unknown as of April 1st.

Overall, the REITs portfolio experienced a heavy loss in 2020 of almost 700,000 dollars. In the meantime, the effect on the apartment portfolios are unknown. But even with this steep decline in value, the REITs portfolio remains more profitable than every apartment portfolio on the January 2009 to May 2020 period. This crisis will likely strengthen retail investors' preference toward real assets.

6.3. Comparison to literature

The real estate literature covers a great deal of issues and anomalies in the market. In this section, the aim is to test the results found in different articles.

6.3.1. REITs and the stock market

The results of the portfolios of apartments and REITs show co-movement between the two. But REITs seems to display more covariance with the stock market (represented by the S&P/TSX). Table 19 displays the correlations of REITs with both stocks and private real estate in the main period.

Table 19. Correlation between real estate, REITs and stocks, 2009-2019

	REITs (Q)	SPTSX	Composite
REITs (Q)			
SPTSX	0,47		
Composite	0,22	0,16	

The variables used to represent real estate, is the composite MLS HPI Index that accounts for every types of properties and every city with 10'000 inhabitants or more. The table shows how REITs are more correlated with the S&P/TSX index (index for the Canadian stock market) than real estate. With the correlation more than twice as important, this result confirms the finding of Ang (2012) who estimated that the correlation between REITs and equity is 0,63 and the correlation between private real estate and REITs is 0,15. While the results of this research are more extreme, the idea that REITs are closer to equity than private real estate persists. Additionally, Chiang, Tsai and Sing (2012) studied how REITs react to financial crisis, and found that, during economic downturns REITs are not an efficient shelter. One of the reasons

being the rises in correlation between equity and REITs during a crisis. Tables 19 and 20 are an illustration of this phenomenon.

Table 20. Correlation between real estate, REITs and stocks, 2007-2008

	REITs (Q)	SPTSX	Composite
REITs (Q)			
SPTSX	0,70		
Composite	0,28	0,44	

The correlation between the S&P/TSX was 0,70 during the subprime crisis, then went down to 0,47 during the 11 years following 2008. Let's note that the correlation between the composite index, representing real estate, and the S&P/TSX also rose during the financial crisis of 2008. In conclusion, the hypothesis that REITs are closer to stocks than private real estate is confirmed by the results of this paper. Moreover, REITs were more correlated with stocks during the 2008 crisis which confirms that REITs are not efficient shelters during crisis.

6.3.2. Seasonality of real estate and REITs returns

Seasonality exists in many financial markets but seems especially prevalent in both the securitized and unsecuritized real estate market. In private real estate, the existence of "hot" and "cold" seasons has been popularized by Ngai and Tenreyro (2013). Through researches on UK and US real estate markets, the authors determined that the first and fourth quarters are associated with less activities and lower prices, while the second and third quarters display above trend numbers in both activities and prices. In similar fashion, REITs are subject to return seasonality through the year. In the REITs' case, the profitable period is the first part of the year (1_{st} and 2_{nd} quarters) and the third and fourth quarters experience lower than average return. The study made conducted by Chmiel and Rodrigues (2019) on REITs determined that the first part of the year yield, on average 8% return, while the second part yields 3%.

Once again, REITs seasonality is closer to stock seasonality rather than private real estate. While private real estate experiences lower return in the first quarter, both REITs and stocks often generate the highest returns of the years.

Table 21. Quarterly performance of the residential REITs portfolio, 2004-2019

|	2004-2008	2009-2019
1st quarter	3,35%	6,38%
2nd quarter	0,94%	4,14%

3rd quarter	3,83%	4,92%
4th quarter	1,84%	0,87%

When conducting the same experiment for residential REITs, the results are similar. During the post-correction period, the sector earned 10,52% on average during the first part of the year (January-June) and only 5,79% on average for the second part of the year. Figure 16 displays the monthly return of residential REITs during the period.

However, the 2004-2008 period had different results, with 4,30% and 5,66% for the first and second parts of the year. The results for the pre-correction and correction periods are less convincing, and the detailed, quarter per quarter returns display questionable results (Table 21). From 2004 to 2008, the third quarter outperforms the second quarter significantly. Moreover, the results for the post-correction period shows comparable performance of the second and third quarters. Thus, the only observation that remains true and significant throughout both periods is the outperformance of the first quarter, especially compared to the fourth quarter. In addition, the popular "January effect" which tries to explain the outperformance of stocks in January is not applicable in this case as January is not the best performing month in the pre and correction periods.

In conclusion, the returns of REITs are indeed seasonal, but the pattern found by Chmiel and Rodrigues (2019) is only true for the post-correction period.

Figure 20. Monthly return of the residential REITs portfolio, 2009-2019
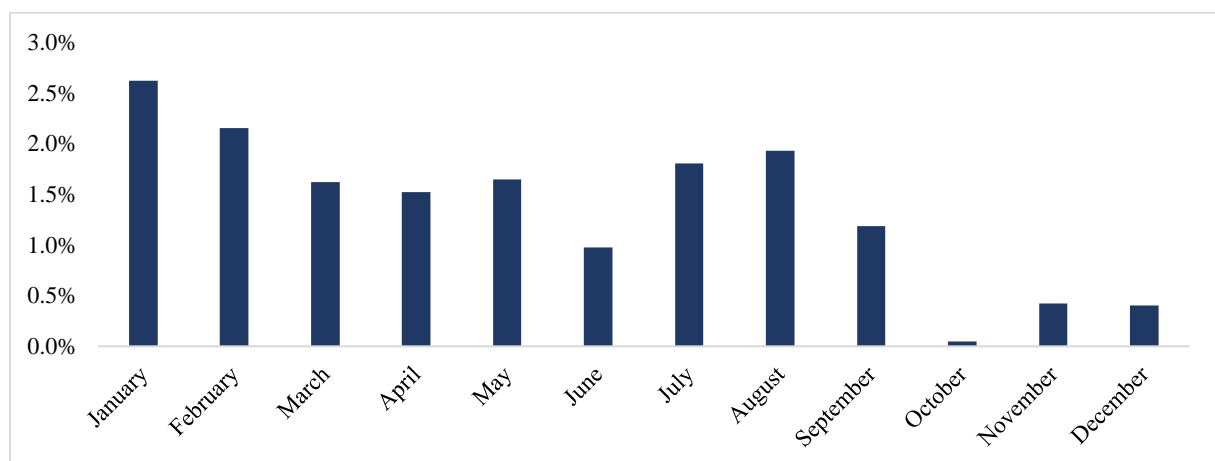
6.3.3. Distribution of real estate and REITs

Xiong and Idzorek (2011) conducted a thorough study on the effect of the skewness and kurtosis on different asset allocations. They found that negative skewness and fat tails have an impact

on optimal asset allocations weights. In this section, this goal is to study the third and fourth moment of REITs in both the correction and post-correction periods. The distribution of returns could partially explain the underinvestment in this asset class for retail and institutional investors. Here the 16-year period between 2004 and 2019 is split into two periods, 2004-2008 and 2009-2019. Additionally, the skewness and kurtosis of the S&P/TSX, to represent the stock market, and the composite MLS HPI, (index on all the types of apartment across Canada) to represent the real estate market, are computed for comparison purposes.

The results are compelling, the subprime crisis had a severe effect on the distribution of private and public real estate. Both investment vehicles experience a significant decrease in their skewness and increase in their kurtosis in the period from 2004 to 2008. The REITs portfolios and the composite index had skewness of -0,83 and -0,66 respectively (table 22). Subsequently, this skewness became positive for the composite index (1,12) and grew for the REITs portfolio (-0,04). In the REITs portfolio's case, the correction had the effect of sharply increase the kurtosis to 11,92, compared to 4,52 in the post-correction period. Interestingly, the MLS HPI composite had a lower kurtosis during the correction than in the post-correction period.

Table 22. Third and fourth moment of real estate, REITs and stocks, 2004-2019

	Skewness		Kurtosis	
	2004-2008	2009-2019	2004-2008	2009-2019
REITs (Q)	-0,83	-0,04	11,92	4,52
S&P/TSX	0,17	0,10	3,25	4,03
Composite	-0,66	1,12	3,52	6,50

To the contrary, the S&P/TSX index had somewhat constant kurtosis and skewness during and after the correction. Overall, the REITs portfolio displayed a negatively skewed and highly spread return distribution during the correction. Then, in the post-correction period the skewness decrease and reach -0,04 and the kurtosis decrease to 4,52, which is still significant. The distribution of the returns in crisis depicts an unattractive investment vehicle. The findings in this paper, especially during the crisis, are congruent with the article of Xiong and Idzorek (2011). This distribution could explain the why investors allocate lower than optimal capital in REITs. The authors also found that US REITs exhibit negative skewness and high kurtosis, which is consistent with the findings on Canadian residential REITs.

In conclusion, the REITs portfolio does exhibit a negatively skewed distribution, with high kurtosis, throughout the 2004 to 2019 period. However, the post-correction period displayed an almost null skewness.

7. Conclusion

The objective of this paper was to assess the profitability of two investment vehicles for retail investors. Additionally, the division in 3 periods, pre-correction, correction and post-correction, allowed for an in-depth study of the performance of both vehicles in different states of the economic cycle. And finally, the results permitted to review findings of the literature.

The results are clear for each of the three periods and depict the portrait of two significantly different investments means. The pre-correction period (2004-2006) displays results that speak for themselves: the REITs portfolio had 28,09% of compounded annual growth rate (CAGR), compared to the 15,15% of the best performing apartment portfolio (Vancouver). Overall, the REITs portfolio reaches a value of $2,101,780.93 and Vancouver's portfolio was valued at $1,522,689.58 at the end of the period. In terms of risk, the securitized portfolio had 14,43% volatility which remains high even for the stock market. In comparison, the S&P/TSX had a volatility of 11,23% during the same period. For the apartment portfolios, the formula used to compute the variance is highly dependent on the horizon of the investment. Thus, during the pre-correction (3 years long) and the correction period (2 years long), the variances are underestimated. Both the adjusted and the unadjusted volatility portray real estate as a safe haven. In reality, the original volatility computed with the data from indexes is a severe underestimation of the true volatility. This problem stems from the construction method of the indexes. And while dozens of articles studied this bias, none found a solution appropriate in every situation. In our case, the formula, proposed by Lin, Liu and Vandell (2009), works in longer investment horizons but seems to underestimate the risks associated with shorter investments. Then, the correction period allowed to study the effect of economic uncertainty on both investment vehicles. Undoubtedly, the REITs portfolios underperformed in this period, displaying negative returns on the two-year period (-13,06%) and significant volatility (28,84%). In the meantime, the best and worst performing apartment portfolios (Ottawa and Vancouver) had respectively, 10,68% and 3,14% of return. The REITs portfolio recorded a loss of $244,185.31, and Ottawa's portfolio a capital gain of $217,914.73 which is equivalent to compounded annual rate of growth of -13.06% and 10,68% respectively. Finally, the post-correction period reversed the trend once again, with the REITs portfolio experiencing a capital gain of $4,578,536.4 (or 16,91% CAGR) against the gain of $2,601,429.1 (or 12,35% CAGR) for the apartment portfolio in Toronto (best performing portfolio on the period). The adjusted risk associated with the Toronto portfolio was

18,65%, which is higher than the 13,66% of the REITs portfolio. For the full period (2004-2019), the REITs portfolio outperformed every apartment portfolio. With the value of the portfolio attaining 8.47 million compared to the 3.88 of the most profitable apartment portfolios or respectively 14,29% and 8,84% compounded annual rate of growth.

These findings are inconsistent with the amount that retail investors invest in both vehicles. Their investment in residential REITs does not even amount to 2% of their investment in private residential real estate. Some possible explanation for this underinvestment could be the novelty of the REITs sector, the risk associated with such investments or the biased outlook of retail investors on the stock market. Moreover, the findings of this paper allowed to confirm the existence of seasonality in the residential REITs sector. Also, by examining the evolution of both the stock market and private real estate, it was possible to determine that REITs are closer to stocks than they are to their underlying assets. Finally, the third and fourth moment of REITs return could be an explanation for the suboptimal allocation in this asset class. Also, the impact of the COVID-19 pandemic on the portfolios confirms that private real estate is more resilient than REITs.

This paper builds on the existing literature on real estate but also raises questions. One of them is the reasons behind the suboptimal allocation in real estate, but especially in REITs for the retail investors. In addition, the underestimation of the risk associated with private real estate seems to be an ongoing problem. The potential for further research is enormous. The assessment of the profitability of each REITs class could be the subject of one of them. Or the explanation of the preference toward private real estate rather than securitized real estate could be another one. And finally, understanding the extent to which private real estate returns impact REITs would be groundbreaking.

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