



Combination of ESG and Momentum: Evidence of the Canadian market

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Abstract

The increasing relevance of Environmental and Social impact of firms on the world has also increased the importance of the ESG score. According to the study performed by Kaiser and Welters, (2019), a higher ESG score decreases the probability that the company is going to be affected by a social movement or any kind of adversity that the market could face. This study analyzes if a double-sorted momentum strategy based on ESG scores and prior returns can outperform and achieve a lower volatility than the Canadian market benchmark and single factor momentum portfolios between the years 2008 and 2020. At the same time, it is tested if the strategy also decreases the volatility of momentum during market crashes.

I find that the double-sorted strategy outperforms the S&P/TSX Composite in most of the portfolios created. My strategy achieves an average return higher than the benchmark and the single factor momentum portfolios. However, the volatility that the double-sorted portfolios present is higher than the benchmark or single factor portfolios, this can be noticed in the fact that the strategy achieves higher maximum return values, but the minimum returns are considerably lower than the single factor strategies or the benchmark. Focusing on market crashes, the strategy still presents a higher volatility with average returns higher than the S&P/TSX Composite or the single factor portfolios.

Keywords: double-sorted portfolio, Canadian benchmark, return, volatility, single factor momentum strategy.

A crescente relevância do impacto Ambiental e Social das empresas no mundo, também aumentou a importância da pontuação do ESG. Segundo o estudo realizado por Kaiser e Welters, (2019), uma pontuação mais elevada do ESG diminui a probabilidade de a empresa ser afectada por um movimento social ou qualquer tipo de adversidade que o mercado possa enfrentar. Este estudo analisa se uma estratégia de momentum dupla baseada na pontuação ESG, e retornos anteriores, pode ter um desempenho superior e apresentar uma volatilidade inferior à do mercado canadiano de referência e carteiras de fatores únicos de 2008 até 2020. Ao mesmo tempo, é testado se a estratégia também diminui a volatilidade do momentum durante as quedas do mercado.

Constato que a estratégia de dupla escolha supera o S&P/TSX Composite na maioria das carteiras criadas. A minha estratégia atinge um rendimento médio mais elevado do que a carteira de referência e o momentum de fator único. Contudo, a volatilidade que as carteiras de dupla selecção apresentam é superior à das carteiras de referência ou de fator único, isto pode ser notado no facto de a estratégia atingir valores máximos de retorno mais elevados, mas os retornos mínimos são consideravelmente inferiores às estratégias de fator único ou de fator único de referência. Centrando-se nas quedas do mercado, a estratégia ainda apresenta uma maior volatilidade e retornos médios superiores aos da S&P/TSX Composite ou das carteiras de fator único.

Palavras-chave: dupla selecção de carteira, benchmark canadiano, retorno, volatilidade, estratégia de momentum de fator único.

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1. Introduction

The goal of investors is to decrease the risk of their investment strategies while achieving the highest return possible (Markowitz et al., 1993). Their investment strategy therefore should consider all information on potential risks during their investment horizon such as the conditions of the market, the industry, volatility, and firm specific risks. In the recent years, many investors also consider the ESG score as a target or parameter in the portfolio formation. Another important aspect that ESG has for investors is the safety provided against many different scenarios such as environmental crisis, social movements, corruption scandals and many other negative aspects that could damage the firm. The better the score, the less probable that this situation could affect the investor and the firm (Kaiser and Welters, 2019). As a result, firms with a high ESG score experienced lower funding costs than firms with low ESG score due to the increasing difficulties in raising new debt and equity (Amel-Zadeh and Serafeim, 2018). Despite the increasing relevance of ESG score and the different studies performed to measure the impact that it has in stock returns and risk management, the answer is not clear. Some studies suggest that considering ESG as an indicator increases the return of a portfolio (Chen and Yang, 2020; Nagy, Kassam and Lee, 2016), while other studies found that it lowers the return especially in some momentum rallies (Kaiser and Welters, 2019). While the answer to the benefits or disadvantages of ESG remains unknown, the implications of including ESG as an indicator for investment are going to remain unclear.

This study analyzes the inclusion of ESG among the decision factors to pick stocks for a strategy in the Canadian market from January of 2008 until the December of 2020. The main question to answer in this paper is the following: *Does a momentum strategy double-sorted by ESG and prior returns can outperform the benchmark in the Canadian market?* The way to tackle the main question of the study is through the performance of a momentum strategy. This strategy considers two main factors, the first factor is the prior returns that the stocks have, and the second factor is the ESG score that the firms have (for the remaining of the study this strategy will be called as “double-sorted strategy”). The study helps to the understanding of ESG as a potential element to sort stocks and achieve higher returns in a portfolio.

The main research question is reformulated in three testable hypotheses. The first hypothesis is that a double-sorted portfolio can outperform the Canadian benchmark during most part of the time. The inclusion of ESG in the strategy can potentialize the performance of the momentum strategy by selecting companies with the best and more innovative policies in the industry. The second hypothesis is that the double-sorted strategy could outperform both single factor

momentum strategies. Consider ESG as one of the factors to select stocks represents an opportunity to decrease the volatility of the portfolio while buying the winners and selling the losers according to prior returns, is a way to potentialize returns of the portfolio. The third hypothesis is related to lower the volatility of the investment strategy especially during crisis periods. Inclusion of ESG represents an approach to decrease the risk of the investment and be protected during a crisis. This situation could be reflected not only in the volatility presented during the whole time of the study, also in specific market crashes such as the ones suffered in 2008 or the beginning of Covid 19 pandemic.

The results obtained, show that the excess return of the double-sorted portfolios in comparison with the benchmark is not statistically significant. Nevertheless, the strategy proposed can outperform the benchmark and the single factor momentum portfolios. However, the analysis done for the transaction costs that this strategy has shown that the strategy is not profitable due to the high turnover of stocks that all the portfolios present. Regarding the volatility obtained for each of the portfolios created during the 13 years of the study, the results show that the double-sorted portfolios have a higher volatility than the single factor strategies or the benchmark. Despite, the analysis of volatility during the crisis of 2008 and indicates that the double-sorted strategy increases its volatility in two or three times, something that the other strategies do not present, during the beginning of Covid 19 pandemic the increase in volatility is proportionally lower in comparison with the single factor strategies. Moreover, during the market crashes remain as the strategy with higher abnormal returns.

The procedure to create the portfolio of the double-sorted strategy is by buying the stocks that belong to the highest quartile of the prior returns and the highest half of the ESG score and sell the stocks that belong to the lowest quartile of the prior returns and the lowest half of the ESG score. The observation period for the formation varies between 3, 6, 9 and 12 months, and holding period between 3 or 6 months, creating a total of 8 different types of portfolios that are updated according to the prior formation and holding periods. The analysis is focused on the comparison between the returns and volatility of the double-sorted strategy with the S&P/TSX Composite (Canadian benchmark), and the momentum strategies that consider ESG and prior returns separately (single factor momentum strategies).

The paper is organized as follows. First, I present a literature review about the research that have been developed about momentum, ESG or the combination of both and the implications that they have found. Second, I explain which data necessary is to perform the study, the sources

of information, some summary statistics, and the process to perform the double-sorted strategy. Third, the empirical results of the study divided in sub-chapters corresponding to each of the hypothesis showing the information in tables and explaining what was found, and an analysis of the implications that trading costs have in the profitability of the strategy. Fourth, the limitations that the information or strategy could present, and finally, a chapter dedicated to mention the conclusions and opportunities for future research.

2. Literature Review

A topic that has gained importance nowadays is the responsibility that the companies transmit to society, the values that they share, the commitment to help the planet with measures against global warming or the inclusion of people to occupy any position inside the firm. Due to this increasing importance, during the last years the literature regarding ESG and investing has been increasing. Moreover, the idea of combining the ESG with Momentum strategy, has been developed by some authors in the recent years. However, the combination of both topics has not been studied in detail by existing literature.

In the 2015 Paris Agreement, the nations committed to balance greenhouse emissions and remove them by the second half of this century (Sachs et al., 2016), creating then the Net Zero Emissions by 2050. This agreement has shifted the way in which companies do business, focusing more on environmental goal than before. Currently more investors are motivated by financial reasons than ethical reasons in using ESG data, and they expect that ESG aspects related to positive screening and active ownership would turn more important in the future (Amel-Zadeh and Serafeim, 2018). Due to this, banks are more selective funding projects according to the environmental or social impact that the project could have, creating a demand to improve the ESG scores of investments. According to Maiti (2020) the largest sustainable strategy in the U.S.A., Canada, Australia, New Zealand, and Aisa excluding Japan is the ESG integration strategy, while in Europe it is the second largest.

Since the beginning of 1970s scholars and investors have published more than 2000 studies regarding the relation between environmental, social and governance with the corporate financial performance (Friede et al., 2015). Despite the great number of studies published many of them conclude opposite ideas about the benefits of considering ESG or any of its components for investment strategies. For example, the usage of ESG in systematic strategies improves the ESG score of the portfolio and outperform a global benchmark (Nagy, Kassam and Lee, 2016), moreover, some studies such as the ones performed by Nofsinger and Varma (2013) or Kaiser

and Welters (2019) agree that portfolios that consider ESG among one of the parameters to invest suffer of a lower crash during crisis times than portfolios that do not consider ESG, nevertheless, they tend to underperform under normal circumstances in the market. On the other hand, the incorporation of ESG could flipped from being a positive predictor of returns to a negative predictor if the investors agree to accept a lower return for a more responsible stock (Pedersen, Fitzgibbons and Pomorski, 2021).

Digging deeper in the literature regarding ESG as risk mitigation in the portfolios, the idea that companies with a higher ESG are better protected against crisis, legal prosecutions, fines, while having a better relationship with governments and the society can help them to mitigate future crashes and perform better than companies with lower ESG scores, especially during crisis times these assets are valuable for investors (Nofsinger and Varma, 2013).

Putting aside the topic of ESG and focusing more on the investment strategy of momentum, it follows the principle that firms whose stocks have performed well in the past, would perform well in the future and stocks that performed poorly in the past would follow a negative trend. Buying the previous winners and selling the past losers is the way to generate abnormal returns (Jegadeesh and Titman, 1993).

Overreaction of the investors has been one of the main attributes that some researchers have conclude that could generate abnormal returns. Moreover, buying previous losers and selling previous winners could generate abnormal returns of 25% in comparison with traditional momentum strategies if the portfolio is held by thirty-six months (De Bondt and Thaler, 1985). On the other hand, Jegadeesh and Titman (1993) conclude that this phenomenon only happens in January and there is not enough proof that this could be explained by overreaction. Contrary as the strategy described before, buying past winners, and selling past losers could achieve positive abnormal returns (Jegadeesh and Titman, 1993; Carhart, 1997; Asness et al., 2013). However, transactions costs have a negative impact on the final performance of the strategy (Lesmond et al., 2004). Another important aspect to consider of this strategy is that after one year of holding the portfolio, the abnormal returns would vanish (Jegadeesh and Titman, 1993; Chen and Yang, 2020).

Despite being a strategy that could generate positive abnormal returns, the risk that it implies for investors is high, especially in market crashes (Kaiser and Welters, 2019), due to this, a considerable proportion of momentum's return are in compensation of the big risk that investors take (Chabi-Yo, Ruenzi and Weigert, 2018). Risk of momentum is highly variable and

predictable, so, managing the highly volatile variable over time, and predict risk virtually eliminates crashes and nearly double the Sharp Ratio of the strategy (Barroso and Santa Clara, 2015), through this strategy they went from a Sharp Ratio of 0.53 to 0.97.

As it was described paragraphs above, ESG has been a way in which firms outperform during market crashes (Nofsinger and Varma, 2013). Combining the benefits of ESG with momentum strategy is in theory a way of minimizing the risk of the portfolio and at the same time achieve positive abnormal returns (Kaiser and Welters, 2019).

Existing literature that uses ESG and momentum combination have used the strategy proposed by Jegadeesh and Titman (1993) of considering the previous 3, 6, 9 and 12 months of returns to select the best stocks, and then hold the portfolio for 3, 6, 9 or 12 months. The only variation that ESG momentum has is that the portfolio is double-sorted, once for the stocks with highest returns through the previous time span and then by the ESG score (Chen and Yang, 2020; Nagy, Kassam and Lee, 2016). Both studies found that the momentum strategies that consider ESG score can achieve abnormal returns, but the results obtained by Chen and Yang (2020) for the Taiwanese found that despite the outperformance, the results were not statistically significant, also they found long-term reversals in the portfolio.

Following a strategy of shorting the lower 20% of the ESG scores and buying the upper 20% of the ESG scores, a portfolio produces a positive abnormal return of up to 20% in North America and Europe (Dorfleitner et al., 2013). Moreover, other strategies that also consider momentum, but they do a double sort of return and ESG score also achieve positive abnormal returns (Chen and Yang, 2020; Nagy, Kassam and Lee, 2016). Despite the advantages in decreasing the overall risk of the strategy, it sacrifices the return in some momentum rallies (Kaiser and Welters, 2019). Another important aspect of the results obtained by Chen and Yang (2020) is that the combination only is profitable for less than one year, after the year the abnormal returns generated disappear. Even more, the portfolios suffer from a reversal in the returns in the long run, this finding agrees with the conclusions of Jegadeesh and Titman (1993) in which the returns dissipate during the next 2 years of the portfolio formation

There does not exist a study that focuses on the Canadian market. My goal so the results of this study are difficult to My study analyzes the implications that ESG has in Canada for investment strategies and compare the result with other strategies performed in this country.

3. Methodology

The next chapter describes the data, its limitations as well as the methodology followed to create the trading strategy.

3.1 Data

The data used for the study was retrieved from Thomson Reuters on a monthly basis from the beginning of 2007 until the end of 2020. The main reason to pick that specific year for the starting of the study was that the S&P/TSX Composite Index has information to download starting on 2007. Another important fact that helped to select the date was that the number of firms that has an ESG score in 2007 is considerably higher in comparison with previous years. For the formation of the portfolio, it is important to have enough information to perform the strategy.

The information obtained for the Canadian Market regarding ESG was downloaded on a monthly basis from the beginning of 2007 until the end of 2020. The number of registers downloaded was over 900 companies. However, the information downloaded presented some errors, missing information so the data needed to be cleaned to avoid any bias, after removing companies that did not present any information, or repeated firms with the same score, a sample of 583 companies was obtained.

In the case of the Return Index, the methodology followed to download the information was similar with the difference that due to the way in which the monthly returns should be obtained, the information was retrieved monthly but starting on December of 2006. The number of firms downloaded was of 5,972 during this period. Following the same logic as the ESG score, the missing information, errors, and repeated firms were deleted from the sample.

For the calculations of the excess return, the Canadian Dollar three months deposit was used as the risk-free rate, like the other data retrieved, this variable was obtained from DsataStream in a monthly basis from 2007 until 2020. Finally, the information used for the regressions was the Fama French Three Factor Model, from the years 2007 until 2020 in a monthly frequency.

3.2 ESG Data

The ESG score measures the performance based on verifiable reported data from the public domain of a firm (Refinitiv, 2022), at the beginning in 2002 approximately 1,000 companies mainly in the U.S. and Europe presented a score, currently 9,000 firms in regions all over the

world present a score. This score is updated annually with a range from 0 to 100, being 100 the maximum level a company can reach.

The methodology followed to calculate this score is by capturing over 630 company-level ESG measurements, and then select 186 of the most relevant parameters considering the industry of the firm. Once that the most important parameters for each firm are considered, they are split in 10 different categories (Resource use, Emissions, Innovation, Workforce, Human rights, Community, Product Responsibility, Management, Shareholders and CSR strategy) that would be grouped into the three main pillars of the score (Environmental, Social and Governance). The ESG pillar score is the relative sum of the category weights, for the environmental and social the weights will vary depending on the industry, but the governance pillar is the same measure for all the firms. *Table 1* presents the summary statistics and the evolution that ESG score have had through the period of the study in the Canadian Market. At the beginning of 2007 most of the companies presented an average a low ESG score but it has been increasing in a continuous trend through the years, increasing 7.19 points the average score. However, the increase of the score does not affect the performance of the study, the only factor that affects the performance is the increasing number of observations, it affects especially in the number of trades done. Another important aspect for the study is the number of firms that report ESG, from 2007 to 2020 there has been an increase of 126.6% of firms having the score among its measures.

Table 1
Summary Statistics of ESG Variable

Year	Observations	Mean	St. Dev.	Median	Min	Max
2007	173	32.17	18.07	27.79	5.58	83.94
2008	249	31.75	18.15	28.22	1.78	82.66
2009	261	33.68	18.79	27.72	3.56	87.79
2010	281	34.35	19.65	29.09	2.62	86.84
2011	265	35.41	19.79	30.81	2.25	89.96
2012	261	36.03	19.84	31.49	1.93	88.66
2013	273	35.32	19.28	30.27	1.12	87.28
2014	285	34.52	19.02	31.25	1.16	83.42
2015	290	35.77	18.88	32.27	3.17	81.3
2016	296	36.04	18.71	31.51	1.3	83.52
2017	301	37.74	18.32	35.19	1.69	82.9
2018	300	39.74	18.59	37.73	1.76	83.87
2019	391	38.90	20.55	36.14	0.84	86.48
2020	392	39.36	21.35	35.88	1.29	86.07

Table 1 shows the summary statistics of the variable ESG-rated companies in Canadian Market from 2007 until 2020, the statistics shown are the number of observations per year, mean, standard deviation of the score, minimum and maximum.

3.3 Total Return Index (RI)

This index shows the theoretical growth in value of a share holding over a period, an assumption done to calculate the value is that the dividends are re-invested to purchase additional units of the equity at the closing price on the ex-dividend date. For the calculation it is assumed that there are 260 weekdays in a year, ignoring the market holidays. Below it is shown the equation used to calculate this value:

$$RI_t = RI_{t-1} * \frac{P_t}{P_{t-1}} \quad (1)$$

When t = ex-date of the dividend payment D_t then:

$$RI_t = RI_{t-1} * \frac{P_t + D_t}{P_{t-1}} \quad (2)$$

Where:

P_t = price on ex-date

P_{t-1} = price on previous day

D_t = dividend payment associated with ex-date t

To calculate the returns from one month to another the following formula was used:

$$R_t = \frac{RI_t}{RI_{t-1}} - 1 \quad (3)$$

R_t = return

RI_t = return index at date t

RI_{t-1} = return index at date $t-1$

Table 2 shows the summary statistics of the Returns obtained from 2007 until 2020. Nevertheless, the sample is big enough to perform the study. The years 2008 and 20011 where the mean is negative show the low performance in comparison with other years, the period

comprehended between these two dates is analyzed in the crisis of 2008 to find if the portfolio created can decrease the volatility. Besides that, almost all the remaining years show a positive average return. One aspect that outstands is the -1.00 as the minimum in all the years, this is due to the closure or delist of some firms during the year.

Table 2
Summary Statistics of Returns Variable

Year	Observations	Mean	St. Dev.	Median	Min.	Max.
2007	3572	0.04	1.5537	-0.02	-1.00	581.00
2008	3560	-0.06	0.4066	-0.07	-1.00	82.33
2009	3503	0.09	0.4694	0.01	-1.00	18.44
2010	3318	0.05	0.4267	0.00	-1.00	47.50
2011	3324	-0.02	0.3070	-0.03	-1.00	19.19
2012	3419	-0.01	0.4361	-0.02	-1.00	108.37
2013	3395	0.00	0.4775	-0.01	-1.00	39.00
2014	3266	0.03	0.8362	-0.01	-1.00	199.00
2015	3103	0.01	0.6140	0.00	-1.00	63.00
2016	2898	0.09	0.9480	0.00	-1.00	243.00
2017	2745	0.06	0.7995	0.00	-1.00	158.00
2018	2720	0.02	2.0630	-0.01	-1.00	641.74
2019	2714	0.01	0.4910	0.00	-1.00	58.15
2020	2650	0.07	0.5419	0.00	-1.00	26.99

Table 2 shows the summary statistics of the variable Return in the Canadian Market from 2007 until 2020, the statistics shown are the number of observations per year, mean, standard deviation of the score, minimum and maximum.

3.4 Portfolio Formation

The portfolios created are equally weighted portfolios such as the strategies followed by Jegadeesh and Titman (1993), Chen and Yang (2020) and Nagy, Kassam and Lee (2016). The main reason to follow this approach is to avoid any overweigh of some industry that could have a higher ESG score, and let the performance of the ESG score among all the firms have a more relevant role in the choosing process. The strategy that this study follows is a double-sorted strategy between the prior returns and the ESG score of the stocks. In the single factor momentum strategies that are used for the comparison, the ESG and prior return factors are considered separately. Each momentum portfolio has two components: the formation period (identified with the letter J), and the holding period (identified with the letter K).

First, the ranks of the stocks for the single factor momentum strategies are according to their prior J-months (J = 3, 6, 9 and 12). In the case of the ESG sample it was split in two halves, for the prior returns the sample was split in quartiles, with the highest group corresponding to the

“winners” and the lowest group to the “losers” in both strategies. The way in which the ESG score or prior return are calculated is shown in *Formula 4* and *Formula 5*. In the highest percentile all the stocks that appear there take part in the group of the “winners” and in the lowest percentile the stocks that take part in the group of the “losers”. Once that the stocks that take part in the formation period of the portfolio are selected, the portfolio is held by the next K-months (K= 3 and 6). The “winner” and “loser” portfolio are not rebalanced during the holding period. The methodology followed is suggested by the paper “Returns to Buying Winners and Selling Losers” by Jegadeesh and Titman (1993).

Prior return of the stock with J months formation and K months holding:

$$R_{J,K} = \sum_{i=t-J}^{t-1} \frac{RI_i}{J} \quad (4)$$

Where:

RI_i = return of the stock at time i

J = 3, 6, 9 or 12 according to the desired formation period

K = 3 or 6 according to the desired holding period

Prior ESG score of the stock with J months formation and K months holding:

$$ESG_{J,K} = \sum_{i=t-J}^{t-1} \frac{ESG_i}{J} \quad (5)$$

Where:

ESG_i = ESG score of the stock at time i

J = 3, 6, 9 or 12 according to the desired formation period

K = 3 or 6 according to the desired holding period

For the double-sorted momentum strategy the formation period (J = 3, 6, 9 and 12) and the holding period (K = 3 and 6) follow the same logic as the single factor momentum strategies, the only difference is the way to select the stocks of the portfolios. The stocks in the highest half of the ESG score of each formation period are compared with the stocks in the highest quartile of the same formation period for the returns. The stocks are included in the “winner” group of the portfolio if they appear in both percentiles. For the loser side of the portfolio, the lowest quartile of the returns and the lowest half of the ESG score are the percentiles considered,

if a stock appears in both sides, it is included among the “loser” group. The main reason to split the information in halves is to have enough information in the “winner” or “loser” groups, without doing it, the double-sorted portfolio does not present a group of “winners” and “losers” in some occasions, all this due to the limited amount of ESG scores. This methodology is suggested by the paper “Do investors exaggerate corporate ESG information” by Chen and Yang (2020) and by the paper “Can ESG add alpha?” by Nagy, Kassam and Lee (2016).

Both double-sorted momentum strategy and the single factor momentum strategy, between each portfolio created there is a gap of 1 month to avoid return reversal effects (Lehmann, 1990; Grinblatt and Moskowitz, 2004).

In *Table 3, Appendix 1 and Appendix 2*, the statistics regarding the three different strategies can be observed. The double-sorted strategy outperforms all the portfolios of the prior return momentum strategy during the study. However, the volatility presented by the prior return portfolios is lower in almost all the cases, just in the formation period of 3 and 6 months with a holding period of 3 months the volatility of the double-sorted strategy is lower. In the comparison with the ESG momentum strategy, the double-sorted portfolios present a higher average return in 7 of 8 portfolios, the only exception is the portfolio with holding and formation period of 6 months. Nevertheless, the volatility of all the double-sorted portfolios is higher than the ESG momentum strategy.

One of the most important results presented in *Table 3* is the Sharpe Ratio of the different strategies. The results show that the values of the double-sorted strategy are higher in all the portfolios in comparison with the single factor strategies. Nevertheless, the Sharpe Ratio obtained by the double-sorted strategy even if it is the better for all the portfolios created, the maximum score is 0.2205 corresponding to the portfolio with a formation period of 12 months and held by 3 months, showing that all the strategies that follow momentum in the Canadian market are highly risky and investors may not be willing to bear that amount of risk.

Table 3 - Continue

Panel A: Relevant statistics for double-sorted Momentum Strategy								
Formation period	3		6		9		12	
Holding Period	3	6	3	6	3	6	3	6
Lowest percentile of the strategy								
Mean	-0.0075	0.0082	-0.0059	0.0207	-0.0104	0.0007	-0.0158	0.0048
St. Dev.	0.0639	0.0443	0.0604	0.0866	0.0896	0.0513	0.0970	0.0750
Skewness	-0.7763	0.8131	-1.0184	2.6877	-1.1404	1.1639	-1.6340	1.5080
Kurtosis	4.8776	2.7608	4.5093	12.0689	6.2496	5.2076	9.0136	5.5210

Sharpe Ratio	-0.1340	-0.1340	-0.1150	0.2261	-0.1283	-0.0075	-0.1736	0.0495
Min.	-0.2078	-0.0486	-0.1698	-0.0900	-0.3231	-0.0843	-0.4027	-0.1064
Max.	0.1251	0.1039	0.1019	0.3420	0.1787	0.1490	0.1787	0.2149
Highest percentile of the strategy								
Mean	0.0029	0.0060	0.0017	0.0076	0.0046	0.0107	0.0038	0.0064
St. Dev.	0.0535	0.0329	0.0509	0.0372	0.0537	0.0393	0.0532	0.0348
Skewness	-0.3050	0.3540	-0.3780	-0.1349	-0.4107	0.4031	-0.3787	0.3323
Kurtosis	4.0905	3.1371	3.6634	4.9905	3.9037	3.9649	3.9633	3.5608
Sharpe Ratio	0.0336	0.1478	0.0123	0.1730	0.0657	0.2413	0.0513	0.1503
Min.	-0.1375	-0.0532	-0.1253	-0.0898	-0.1290	-0.0634	-0.1254	-0.0547
Max.	0.1117	0.0786	0.1085	0.0919	0.1171	0.0953	0.1171	0.0852
Winner - Loser strategy								
Mean	0.0104	-0.0022	0.0076	-0.0131	0.0151	0.0099	0.0196	0.0015
St. Dev.	0.0530	0.0335	0.0593	0.0864	0.0776	0.0449	0.0841	0.0675
Skewness	-0.1331	-0.4105	0.4477	-2.5154	0.3716	-1.7610	0.6995	-2.0648
Kurtosis	2.2916	3.1505	3.9559	11.6560	4.8577	7.9640	5.5899	7.9265
Sharpe Ratio	0.1753	-0.0994	0.1091	-0.1641	0.1803	0.1968	0.2205	0.0064
Min.	-0.1075	-0.0850	-0.1081	-0.3293	-0.1815	-0.1395	-0.1789	-0.2103
Max.	0.1055	0.0515	0.1674	0.1247	0.2320	0.0714	0.2773	0.0875

Table 3 shows the summary statistics of the different portfolios created for the double-sorted Momentum strategy since its start in 2008 until 2020, the table is split in three parts: the “losers” that are shown in the “Lowest percentile of the strategy”, the “winners” that are shown in the “Highest percentile of the strategy” and the portfolio created that is the section “Winner – Loser strategy”.

4. Empirical Results

This section is dedicated to presenting the main results found for the double-sorted strategy. To analyze the performance of the double-sorted portfolios it is necessary to compare first the general performance of the double-sorted strategy with the Canadian benchmark, as well as the single factor momentum strategies. Once these comparisons are done, the analysis is focused in two market crashes: the crisis of 2008, and the beginning of Covid 19 pandemic.

Before doing all the analysis with the other portfolios, I performed an analysis of the correlation of the double-sorted portfolio with a benchmark of the momentum strategy that also incorporates ESG as one of the ways to sort stocks. The selected benchmark was the AQR Momentum (a global investment manager), and the specific portfolios picked for the analysis were the ESG and Return momentum strategies for the global market (these portfolios exclude the stocks from the U.S.).

The correlation between the different strategies performed and the AQR Momentum is shown in Table 4. The correlation is calculated considering if the strategy uses ESG or prior Returns

of the stocks. In the case of the double-sorted portfolio, it is compared with the AQR Momentum ESG and Return portfolio.

The results obtained show that in almost all the different portfolios, the correlation calculated is below the 50%. The only exception is the double-sorted strategy with formation period of 9 months and holding period of 6 months, this portfolio represents the most similar behavior to the AQR Returns Momentum strategy.

Behaving closer to a benchmark such as AQR Momentum represents an opportunity to achieve abnormal returns. From all the different momentum strategies, the double-sorted portfolios are the closest to replicate the AQR Return Momentum performance, but the desired high correlation is far to be reached.

Table 4
Statistics and Correlation of Return Momentum Portfolios (%)

Formation	J =	3	6	9	12				
Holding	K =	3	6	3	6	3	6	3	6
Panel A: Returns Momentum									
Correlation to AQR Returns Momentum		20.85	26.65	23.75	30.59	25.62	20.88	24.41	32.56
Panel B: ESG Momentum									
Correlation to AQR ESG Momentum		28.35	21.80	30.87	21.22	29.99	24.56	31.06	25.99
Panel C: Returns & ESG Momentum									
Correlation to AQR Returns Momentum		40.10	37.45	39.19	30.42	44.64	54.81	47.01	40.79
Correlation to AQR ESG Momentum		15.82	9.04	13.66	11.63	33.01	34.70	36.84	24.55

Table 4 shows the correlation of the strategies followed with the AQR momentum, for Panel A was considered the International Stock Momentum portfolio of AQR for the correlation. For Panel B the correlation was done with the equality weighted portfolio of AQR. For Panel C the correlation performed was considering both strategies chosen before. The time span was from 2008 until 2020 for the analysis. Results are shown in percentage.

4.1 Double-sorted Momentum Strategy

Table 5 presents the results obtained by the double-sorted momentum strategy. The results show that despite the “winner” group can outperform the “loser” group in many of the double-sorted portfolios created, the difference in the results is not significantly different from zero. The fact that the returns of the portfolios are not significant shows that including ESG among the factors to pick stocks inside a momentum strategy has no effect in the returns. So, including ESG as a

predictor of a better performance is not worthy for investors that try to maximize their returns following a momentum strategy.

Regarding the performance of the different portfolios, even if their results are not statistically significant from zero, the return of all the portfolios with holding period of 3 months is higher than the “winner” or “loser” groups. However, as it was shown in *Table 3*, the volatility presented by the double-sorted strategy is higher than the “winner” or “loser” portfolios. In the case of the holding period of 6 months the returns presented are higher than the “loser” portfolios but lower than the “winner” portfolios, these results combined the high volatility of the double-sorted strategy makes that investors consider other strategies such as the single factor momentum as a better and safer choice.

Table 5

Return to momentum strategy considering returns & ESG

		Considering prior returns and ESG	
J	K =	3	6
3	Sell	-0.0025 (0.73)	0.0014 (0.87)
	Buy	0.0010 (0.34)	0.0010 (0.86)
	Winner - Loser	0.0035 (1.22)	-0.0004 (0.31)
6	Sell	-0.0020 (0.61)	0.0034 (1.12)
	Buy	0.0006 (0.21)	0.0013 (0.96)
	Winner - Loser	0.0025 (0.80)	-0.0022 (0.71)
9	Sell	-0.0035 (0.73)	0.0001 (0.07)
	Buy	0.0015 (0.54)	0.0018 (1.27)
	Winner - Loser	0.0050 (1.21)	0.0016 (1.04)
12	Sell	-0.0053 (1.02)	0.0008 (0.30)
	Buy	0.0013 (0.45)	0.0011 (0.86)
	Winner - Loser	0.0038 (1.46)	0.0015 (0.11)

Table 5 presents the monthly returns of the momentum strategy that consider prior return index, and ESG score of the firms from 2008 until 2020. The information was split in quartiles for the return index and halves for the ESG score based on its previous 3, 6, 9 and 12 month returns.

Portfolio of “Buy” contains the firms in the higher quartile of the return index and higher half of the ESG score, and portfolio “Sell” contains the firms in the lowest quartile of the return index and lower half of the ESG score, the portfolio “Winner – Loser” is the result of buying the firms that after the double sorting are included in the “winners” and selling the firms that belong to the “loser” group, then the portfolios are held by 3 and 6 months subsequent after the formation and are not rebalanced during the holding period. The t-statistics associated to each result are shown in parentheses. *, **, and *** denote the statistical significance at 10%, 5% and 1% respectively.

Considering only the Winner – Loser portfolio for the double-sorted strategy, Table 6 shows the alphas for the CAPM and Fama-French 3 factor model. The results show that only the portfolio with 12 months formation and 6 months holding period is significantly different from zero. So, this strategy cannot be explained by market risk, size risk, or book-to-market risk. Thus, the result of this portfolio cannot be attributed to the risk taken by investors.

Table 6
Fama-French and CAPM adjusted returns

	3 months holding period		6 months holding period	
	3FF	CAPM	3FF	CAPM
3	-0.0003 (0.04)	0.0024 (0.25)	0.0173 (1.66)	0.0132 (1.29)
6	-0.0191 (1.05)	-0.0132 (0.73)	0.0116 (0.91)	0.0106 (0.87)
9	0.0126 (1.27)	0.0157 (1.59)	0.0175 (1.48)	0.0196 (1.72)
12	-0.0055 (0.32)	0.0018 (0.11)	0.0237* (1.91)	0.0252** (2.10)

Table 6 present the returns adjusted with the CAPM model and the Fama-French 3 factors model for the ESG& Returns Momentum strategy with a holding period of 3 and 6 months, and formation period of 3, 6, 9 and 12 months. The t-statistics associated to each result are shown in parentheses. *, **, and *** denote the statistical significance at 10%, 5% and 1% respectively.

To show the performance of the strategy in the long-run, Table 7 shows the different cumulative returns that the strategy has. The results obtained show that all the 3 months held portfolios have a positive monthly cumulative return for the 39 different portfolios used. However, the portfolios that held by 6 months, only the one with 9 months prior formation has a positive cumulative return. In the long-run portfolios that are held by a shorter period present a better

performance such as the effect described by Jegadeesh and Titman or (1993) or Chen and Yang (2020).

Table 7
Cumulative Returns

Portfolio	3 months holding period				6 months holding period			
	J = 3	J = 6	J = 9	J = 12	J = 3	J = 6	J = 9	J = 12
1	-0.0034	-0.0142	-0.0008	-0.0027	-0.0019	-0.0036	-0.0009	-0.0019
2	-0.0128	-0.0221	-0.0170	-0.0136	-0.0083	-0.0229	0.0035	0.0065
3	0.0185	-0.0595	0.0453	0.0714	-0.0230	-0.0460	-0.0212	-0.0215
4	-0.0068	-0.0944	-0.0193	0.0078	-0.0275	-0.0462	-0.0097	-0.0133
5	0.0093	-0.1056	-0.0263	0.0018	-0.0320	-0.0414	-0.0066	-0.0134
6	0.0099	-0.1010	-0.0058	0.0268	-0.0378	-0.0440	-0.0116	-0.0204
7	0.0358	-0.0798	0.0064	0.0408	-0.0324	-0.0438	-0.0024	-0.0184
8	0.0233	-0.0833	0.0097	0.0468	-0.0381	-0.0443	0.0005	-0.0127
9	0.0431	-0.0641	0.0178	0.0623	-0.0370	-0.0408	0.0064	-0.0091
10	0.0318	-0.0658	0.0184	0.0668	-0.0286	-0.0365	-0.0015	-0.0097
11	0.0378	-0.0685	0.0169	0.0658	-0.0330	-0.0168	0.0052	0.0023
12	0.0534	-0.0516	0.0194	0.0684	-0.0358	-0.0139	0.0137	0.0103
13	0.0323	-0.0566	0.0140	0.0623	-0.0313	-0.0102	0.0189	0.0125
14	0.0512	-0.0520	0.0068	0.0557	-0.0264	-0.0096	0.0149	0.0128
15	0.0616	-0.0467	0.0140	0.0610	-0.0218	-0.0072	0.0159	0.0155
16	0.0788	-0.0426	0.0403	0.0873	-0.0219	-0.0716	0.0159	-0.0231
17	0.0999	-0.0515	0.0034	0.0459	-0.0194	-0.0667	0.0176	-0.0211
18	0.1339	0.0014	0.0754	0.1190	-0.0189	-0.0686	0.0175	-0.0176
19	0.0967	-0.0185	0.0507	0.0928	-0.0167	-0.0667	0.0251	-0.0124
20	0.0914	-0.0124	0.0762	0.1171	-0.0086	-0.0590	0.0334	0.0017
21	0.1189	0.0087	0.0737	0.1126	-0.0053	-0.0602	0.0316	0.0011
22	0.1317	0.0185	0.0840	0.1229	-0.0098	-0.0612	0.0333	-0.0016
23	0.1241	0.0671	0.1314	0.1704				
24	0.1290	0.0667	0.1507	0.1897				
25	0.1063	0.0347	0.1066	0.1465				
26	0.1322	0.0536	0.1300	0.1681				
27	0.1594	0.0449	0.1339	0.1719				
28	0.1471	0.0487	0.1198	0.1519				
29	0.1516	0.0699	0.1230	0.1555				
30	0.1473	0.0623	0.1228	0.1572				
31	0.1243	0.0412	0.1063	0.1409				
32	0.1333	0.0412	0.1194	0.1529				
33	0.1444	0.0435	0.1251	0.1591				
34	0.1388	0.0380	0.1156	0.1632				
35	0.1424	0.0616	0.1423	0.1940				
36	0.1485	0.0705	0.1476	0.2022				
37	0.1301	0.0858	0.1732	0.2278				
38	0.1322	0.1059	0.1863	0.2409				
39	0.1229	0.0838	0.1703	0.2250				

Table 7 presents the monthly cumulative returns for all the portfolios created, in the case of the 3 months holding period there is a total of 39 portfolios and for the 6 months holding period there are only 22 different portfolios.

4.2 Double-sorted Momentum Strategy compared to S&P/TSX Composite

To determine if the returns of the double-sorted portfolios are statistically significant compared to the returns of the benchmark, the excess return for all the portfolios are calculated, the results are displayed in Table 8. For the holding period of 3 months all the portfolios of the double sorted strategy present on average a higher return than the benchmark. However, for the 6 months holding period just the 9 months formation portfolio has positive excess returns. Despite the majority outperform the benchmark, the results are not significantly different than zero. So, there is no evidence of a better performance of the double-sorted strategy in comparison with the benchmark even if the results obtained on average were higher, this finding indicates that the first hypothesis where it mentions that the portfolios can outperform the Canadian benchmark is not fulfilled.

Formation period	Holding period	
	3	6
3	0.0078 (0.78)	-0.0072 (0.76)
6	0.0050 (0.51)	-0.0181 (0.96)
9	0.0125 (0.86)	0.0049 (0.40)
12	0.0171 (1.09)	-0.0035 (1.09)

Table 8 shows the excess return of the double-sorted strategy between ESG score and prior returns less the S&P/TSX Composite from the years 2008 until 2020. The *t*-statistics associated to each result are shown in parentheses. *, **, and *** denote the statistical significance at 10%, 5% and 1% respectively.

Since the beginning of 2008 until December of 2020, the volatility of the returns presented by the S&P/TSX Composite is 4.07%, with an average return of 0.48%. All the double-sorted portfolios outperform the benchmark in at least 50% of the occasions through the period of study as it is shown in Appendix 3. Despite this performance, the high volatility presented by all the double-sorted portfolios, the performance of the benchmark is more consistent, making the benchmark a safer choice but in some momentum rallies less rewarding.

4.3 Prior Returns Momentum Strategy

The first strategy performed was the momentum strategy that only considers prior returns, the results obtained for this strategy are shown in *Table 9*. The “loser” portfolios held by 3 months are statistically significant at 10%, 5% and 1% level. Showing that considering prior “loser” stocks to invest and achieve positive abnormal returns in the future is possible, another fact to point out is that all the “loser” portfolios have a higher return than the “winner” group, thus, the return of the momentum strategy is always negative for the 3 months holding period.

Analyzing the results of the “loser” group, all the returns with a holding period of 6 months are significant at 10% level for all the formation periods. For the formation and holding period of 6 months, the return is also significant at 5% level. For the holding period of 3 months, all the results are significant at 1% level. All the returns obtained by the “loser” group are higher than the “winners”, making that the momentum strategy has negative average returns.

In the case of the strategy of buying winners and selling losers, all the holding period of 3 months is significant at 1% level, for the holding period of 6 months only the portfolios of 3 and 6 months of formation are significant. Nevertheless, the return obtained by the momentum strategy are negative, showing that momentum effect instead of helping to achieve positive returns works in the opposite way, these results are consistent with the findings of De Bondt and Thaler (1985).

Table 9
Return to momentum strategy considering returns

J	K =	Holding prior returns	
		3	6
3	Sell	0.0137*** (2.95)	0.0036* (2.00)
	Buy	-0.0010 (0.29)	0.0005 (0.24)
	Winner - Loser	-0.0151*** (4.66)	-0.0032*** (5.29)
6	Sell	0.0121*** (2.74)	0.0045** (2.34)
	Buy	-0.0004 (0.12)	0.0011 (0.58)
	Winner - Loser	-0.0128*** (3.68)	-0.0035** (2.82)
9	Sell	0.0116*** (2.79)	0.0034* (2.01)
	Buy	0.0013 (0.36)	0.0022 (1.08)

	Winner - Loser	-0.0106*** (3.24)	-0.0012 (0.91)
12	Sell	0.0112*** (2.87)	0.0035* (1.94)
	Buy	0.0013 (0.38)	0.0019 (0.99)
	Winner - Loser	-0.0101*** (3.21)	-0.0016 (1.44)

Table 9 presents the monthly returns of the momentum strategy that consider prior return index of the firms from 2008 until 2020. The information was split in quartiles based on its previous 3, 6, 9 and 12 month returns. Portfolio of “Buy” contains the firms in the higher quartile and portfolio “Sell” contains the firms in the lowest quartile, the portfolio “Winner – Loser” is the result of buying the firms in the upper quartile and selling the firms in the lowest quartile, then the portfolios are held by 3 and 6 months subsequent after the formation and are not rebalanced during the holding period. The t-statistics associated to each result are shown in parentheses. *, **, and *** denote the statistical significance at 10%, 5% and 1% respectively.

Comparing the performance of this strategy with the S&P/TSX Composite, in most part of the months, the performance of the strategy is lower than the benchmark, achieving the best results for the holding period of 6 months and formation of 9 and 12 months, in these portfolios only in 45% of them were able to outperform the benchmark.

4.4 Prior ESG Momentum Strategy

In the case of the momentum strategy that only considers prior ESG scores for the formation period the results are presented in Table 10. None of the portfolios for the different formations and holding periods are statistically significant at any level, this means that a momentum effect generated by ESG score does not exist in the Canadian market. Focusing on the returns of the momentum strategy, the results show that from the 8 different portfolios created only 50% of them present a positive return.

However, this strategy is the one with the lowest volatility even if it is compared with the benchmark, so including ESG as a decision factor in a momentum strategy represents an advantage in the returns and volatility that a portfolio can achieve.

Table 10

Return to momentum strategy considering ESG			
		Considering prior ESG	
J	K =	3	6
3	Sell	0.0003	0.0016

		(0.13)	(1.28)
	Buy	0.0005	0.0011
		(0.23)	(1.11)
	Winner - Loser	0.0001	-0.0006
		(0.19)	(1.07)
6	Sell	0.0001	0.0015
		(0.25)	(1.23)
	Buy	0.0005	0.0010
		(0.25)	(1.08)
	Winner - Loser	0.0004	-0.0005
		(0.50)	(0.97)
9	Sell	-0.0006	0.0014
		(0.14)	(1.08)
	Buy	0.0003	0.0009
		(0.14)	(0.89)
	Winner - Loser	0.0009	-0.0005
		(1.11)	(0.97)
12	Sell	-0.0006	0.0010
		(0.26)	(0.81)
	Buy	0.0002	0.0008
		(0.10)	(0.82)
	Winner - Loser	0.0008	-0.0002
		(1.06)	(0.43)

Table 10 presents the monthly returns of the momentum strategy that consider prior ESG score of the firms from 2008 until 2020. The information was split in halves based on its previous 3, 6, 9 and 12 month returns. Portfolio of “Buy” contains the firms in the higher half and portfolio “Sell” contains the firms in the lowest half, the portfolio “Winner – Loser” is the result of buying the firms in the upper half and selling the firms in the lower half, then the portfolios are held by 3 and 6 months subsequent after the formation and are not rebalanced during the holding period. The t-statistics associated to each result are shown in parentheses. *, **, and *** denote the statistical significance at 10%, 5% and 1% respectively.

Comparing the performance of this strategy with the S&P/TSX Composite, the performance of the different portfolios most part of the time is below the benchmark. In any of the different portfolios the number of times that the strategy has a better performance than the index is higher than 50%, comparing this with the momentum that only considers prior returns, the ESG momentum has a better performance and lower volatility, making the ESG score a better factor than prior returns to predict positive returns in a single factor momentum strategy.

4.5 Comparison between double-sorted strategy and single factor momentum strategies

As well as the strategy that only consider prior ESG score, the results of the double-sorted portfolio are not statistically significant at any level. Another important result obtained is that the returns of the double-sorted strategy are higher than the ESG momentum strategy in almost all the formation and holding periods, the only portfolio that does not outperform the ESG momentum strategy is the formation period of 6 months and holding period of 6 months.

In the case of the momentum strategy that only considers prior returns, it is statistically significant for almost all the portfolios. However, the returns presented by the momentum strategy are negative, this is the main difference with the double-sorted strategy created where all the returns were higher than the momentum strategy that follows prior returns. Despite this situation, it does not show statistical significance at any level.

The goal of outperforming the other momentum strategies is fulfilled, just in the case of the ESG momentum strategy with holding and formation period of 6 months the goal is not reached, so in general the returns of the double-sorted strategy are better than the single factor portfolios. However, the volatility presented by the double-sorted strategy is higher in most part of the portfolios in comparison with ESG or prior returns momentum strategies. This situation represents a major treat at choosing the double-sorted portfolios as the optimal among the different strategies that follow a momentum.

4.6 Performance during crisis

For this analysis two different periods of time are selected, the first period begins in April of 2008, until November of 2011, this period represents the crisis of 2008, and the ending date was selected specifically when the S&P/TSX Composite starts to show signs of recovery. The second crisis period correspond to Covid 19 pandemic, the dates selected are from February of 2020 until November of 2020, the starting date for this selection is when the S&P/TSX Composite showed a decline in its value while the pandemic started in Canada. The analysis done is for the benchmark of the Canadian market, the double-sorted momentum strategy and the single factor momentum strategies.

The results of the study for the Crisis of 2008 show that the double sorted momentum strategy outperform the benchmark most part of the time. However, the volatility presented during the period is at least twice than the volatility of the benchmark. A thing to remark about the different

strategies created is the fact that they present on average a negative return, just the portfolios with a formation period of 3 months and holding period of 3, 9 and 12 months present a positive return, this information is shown in *Table 11* and the behavior during this period can be seen in *Figure 1* and *Figure 2* shown in the Appendices section.

Table 11

Comparison of Canadian Benchmark and the double sorted strategy for 2008 Crisis									
K =	3				6				Benchmark
J =	3	6	9	12	3	6	9	12	
Volatility	13.00%	17.35%	12.96%	14.68%	9.73%	12.02%	12.44%	14.36%	5.66%
Average Return	0.0166	0.0085	0.0083	0.0214	-0.0300	-0.0396	-0.0051	0.0189	0.0039
Minimum	0.2253	-0.6631	-0.3726	-0.3727	-0.2447	-0.4748	-0.5303	0.6474	-0.1667
Maximum	0.3420	0.3201	0.2454	0.3311	0.1990	0.2285	0.1793	0.2116	0.1146

Table 11 shows comparison of volatility, average return, minimum and maximum between the different portfolios of the double sorted momentum strategy and the Canadian benchmark for the Crisis of 2008, the period considered was from April 2008 until November 2011.

Moreover, the comparison with the single factor portfolios, as well as the benchmark the volatility of the double-sorted portfolio is higher than each of the other two strategies. Focusing on the comparison with the ESG momentum strategy, the volatility of the double-sorted portfolios is considerably higher than the one presented by the portfolios of the ESG strategy, but the proportional increase presented is higher for the single factor strategy. However, the average return presented by the ESG strategy is higher in most of the portfolios created, results are show in *Appendix 4*.

For the results of the Covid 19 pandemic, the double sorted portfolio outperforms the benchmark just in the portfolios with holding period of 6 months and formation period of 3 and 6 months. Also, the volatility presented by all the portfolios is higher than the volatility presented by the benchmark. However, in comparison with the Crisis of 2008, the volatility of the strategy even if it is higher, there is a decrease in the proportional increase.

Analyzing the average returns of the double-sorted strategy, 5 of the 8 portfolios created present positive average return, being the portfolio of holding period of 3 months and formation period of 12 months the one with the highest average return. The double-sorted portfolio with the lowest volatility has an excess return of -2.4% in comparison with the benchmark. This information is shown in *Table 12* and the behavior during this period can be seen in *Figure 3* and *Figure 4* shown in the Appendices section.

Table 12**Comparison of Canadian Benchmark and the double sorted strategy for Covid 19 pandemic**

K =	3				6				Bench mark
	J = 3	6	9	12	3	6	9	12	
Volatility	5.79%	8.06%	9.26%	9.19%	9.81%	10.37%	8.87%	8.95%	5.22%
Average Return	-0.0023	0.0209	0.0308	0.0309	-0.0085	0.0049	0.0115	-0.0115	0.0217
Minimum	-0.0887	-0.1290	-0.1105	-0.1065	-0.1683	-0.1399	-0.1144	-0.1516	-0.0590
Maximum	0.0819	0.0979	0.1912	0.1912	0.1257	0.1351	0.1512	0.1003	0.1079

Table 12 shows comparison of volatility, average return, minimum and maximum between the different portfolios of the double sorted momentum strategy and the Canadian benchmark for the Covid 19 pandemic, the period considered was from February 2020 until November 2020.

For the other two single factor momentum strategies, the volatility presented in comparison with the double-sorted portfolios is lower for the ESG strategy, in the case of the prior Return strategy the volatility is similar only for the portfolios with a holding period of 6 months. One important aspect is that the proportional increase in volatility of the single factor strategies is higher than the double-sorted portfolios. Moreover, the average returns of the double-sorted portfolios are higher in most part of the occasions than the other two strategies. These results are shown in *Appendix 5*.

Although the volatility presented during both market crashes and the lower minimums reached by the double-sorted strategy are a disadvantage in comparison with the single factor strategies or the benchmark, the returns obtained especially during the Covid 19 pandemic are higher in most of the cases. For that reason, using a double-sorted momentum between ESG and Returns does not represent a way to mitigate risk during periods where the market is not performing well, but the returns that could be achieved represent an incentive for the investors.

4.7 Transaction costs

The analysis performed for the transaction costs is based on the average number of trades done by each portfolio of the double sorted strategy during the study, according to the study performed for the Canadian and U.S. market of Foerster and Karolyi (1998), the percentages used for trading stocks are between the ranges of 0.6% and 8%. In the case of the double-sorted strategy performed each month presents a high rotation of the stocks, these results are shown in *Appendix 6*. The high rotation presented by all the portfolios implies a high cost to maintain the strategy that in the long run it is no longer profitable for investors. That is the case if the strategy cost picked is 1%, all the portfolios of the double-sorted strategy decrease their value

if they are compared with the value that they have in their formation. In the case of picking the minimum of 0.6%, just the portfolios with 9 and 12 months formation period and 3 months holding period achieve a higher value, the results are shown in *Table 13*. These results show that the constant turnover of stocks inside the portfolios make this strategy unprofitable unless the trading cost is below the minimums established by literature.

Table 13
Result after trading cost of the double-sorted portfolios

Formation	3		6		9		12	
Holding	3	6	3	6	3	6	3	6
Initial Cost of the portfolio	423.94	423.94	503.43	503.43	384.19	384.19	357.70	357.70
Cost of 0.6%	350.87	266.38	395.34	241.63	416.67	352.90	466.53	261.19
Cost of 1%	200.18	184.49	254.48	179.91	300.41	284.11	347.74	206.87

Table 13 shows the Initial cost of the portfolio at the formation period (in January of 2008) and the value that all the portfolios have at the end of the study considering a trading cost of 0.6% and 1%. To calculate this, I used the average cost of the stock from the year 2008 until 2020 (\$13.25 CAD) and the average number of trades per portfolio.

5. Limitations

Despite the popularity of the ESG as a relevant topic for companies and investors, the information retrieved about companies that show a score during the time span is limited, since 2007 until 2020 the number of observations of ESG score represents only the 15% in comparison with the total number of observations that present a Return Index record during this period in the Canadian market. However, the ESG sample reduce its size after cleaning missing or repeated scores, being a problem the quality of the data especially during the first years of the study.

Most of the companies that present an ESG score are big companies, so the analysis of the study performed implicitly is focused only on the biggest firms in the Canadian market. Excluding small and medium firms represents a limitation in the diversification of the portfolio because not all the industries have the same relevance in the Canadian Market, so using just big companies is a way in which some industries are excluded.

Another important limitation is the fact that the low scores and limited amount of ESG scores affect the way in which the percentiles of the ESG are selected, especially during the first years of the study. Consider deciles or quintiles (such as the strategies followed in other papers) is not possible to perform a double-sorted strategy in this study because in most part of the months

the “winner” group is empty or presents just one firm. To solve this problem and have enough information the ESG sample needed to be split in halves and not into quintiles or deciles, this leads to the inclusion of low ESG scores in the sample of the winners during the first years of the study.

Finally, the last limitation presented during this study was the way in which the firms’ ESG would be considered. For the purpose of this study, the higher the ESG score that a firm has, the better. The percentual change that ESG score presents during the period is not considered, so this study analyzes the companies with high or low ESG and not the improvement or decrease in proportion of the previous score. The reason to follow this approach is the fact that the ESG score changes annually, so for many formation periods the percentual change would be zero, considering the score instead of the change is a way to have information to compare during all the time.

6. Conclusion

This research shows the key findings of a double-sorted momentum strategy that considers prior returns and ESG score as the main factors to buy or sell stocks during the years 2008 and 2020 in the Canadian market. For the performance of this double-sorted strategy a total of 8 different portfolios are created with the combination of holding periods of 3 and 6 months, and formation periods of 3, 6, 9 and 12 months.

One of the key findings of this research is that the double-sorted momentum strategy created can outperform the S&P/TSX Composite for the period studied, achieving a higher return in all the 3 months holding portfolios and just a higher return in the 6 months holding portfolio with 9 months formation period. Despite this performance, the results found are not statistically significant, showing that including ESG as a predictor of future positive returns in a momentum strategy is not the optimal choice, these results are consistent with the findings of Chen and Yang (2019). Moreover, the volatility that the strategy presented is at least twice as the benchmark, generating situations of considerably higher or lower returns in comparison with the S&P/TSX Composite.

An analysis of the trading costs that the strategy has shown that the high rotation of stocks in the portfolios makes the strategy unprofitable in almost all the cases even if the trading cost assumed is 1%. However, the most successful strategies were the 3 months holding portfolios

with 6 and 9 months of formation periods, these strategies were able to be profitable with the minimum trading cost used for the Canadian market.

Another relevant finding is the comparison with the single factor momentum strategies, same as it happened with the benchmark, almost all the portfolios of the double-sorted strategy outperform the similar portfolio of the single factor strategies. Nevertheless, the results found are not statistically significant and the volatility of the double-sorted portfolio is higher than the other two strategies, especially in the comparison with the momentum strategy that only considers ESG.

Although the volatility of the double-sorted strategy presented during all the time of the study is higher than the volatility presented by the benchmark or the single factor portfolios, the Sharpe ratio indicates that the double-sorted strategy is more attractive for investors. However, during the crisis of 2008 one negative aspect that the created strategy presents is the higher proportional increase in comparison with the other strategies, achieving higher results, but having a volatility of two or three times its average. Nevertheless, during the Covid 19 pandemic the proportional increase of the volatility is the lowest, at the same time it achieves higher results than most of the strategies. So, the goal of decrease the volatility in those specific periods is not achieved completely, but one thing to remark is the proportional decrease in volatility from a crisis at the beginning of the study to a market crash at the end of the period of study.

After performing the study there are some results and situations to point out that future research can study in detail, such is the case of the analysis of the impact of the trading cost for this strategy, due to the high rotation of stocks in the portfolios, the number of trades that need to be done to perform the strategy damages the final return. For this reason, further studies can help to explain if the double-sorted strategy can work with stocks that the trading costs are low or how to decrease the turnover of stocks In the portfolio.

Another important aspect is the impact of ESG in the volatility of the strategy, if it was shown that the double-sorted strategy has a higher volatility, the momentum strategy that only considers the ESG scores is the one with lowest volatility, even lower than the benchmark, so analyzing this can represent a way of understanding why the volatility presented is higher in the double-sorted strategy with the goal of proposing an alternative to achieve a higher return but a lower volatility.

Finally, the main limitation found especially during the first years of the study is the lack of companies with an ESG score. The popularization of this score represents an opportunity to retrieve a higher number of stocks that present an ESG score and group the percentiles according to higher ESG standards.

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8. Appendices

Appendix 1

Appendix 1

Relevant statistics for prior Returns Momentum Strategy

Formation period	3		6		9		12	
Holding Period	3	6	3	6	3	6	3	6
Lowest percentile of the strategy								
Mean	0.0417	0.0219	0.0366	0.0276	0.0351	0.0207	0.0340	0.0211
St. Dev.	0.0882	0.0515	0.0834	0.0553	0.0787	0.0483	0.0739	0.0511
Skewness	0.3129	0.5357	0.3914	0.3080	0.5279	0.3196	0.7047	0.5534
Kurtosis	5.8023	2.8977	5.8771	1.9351	5.4874	2.3062	5.6190	2.1806
Sharpe Ratio	0.4590	0.4590	0.4245	0.4756	0.4315	0.4031	0.4435	0.3901
Min.	-0.2258	-0.0645	-0.2100	-0.0574	-0.1836	-0.0584	-0.1611	-0.0544
Max.	0.3076	0.1266	0.2949	0.1200	0.2808	0.1086	0.2740	0.1206
Highest percentile of the strategy								
Mean	-0.0029	0.0028	-0.0012	0.0069	0.0038	0.0136	0.0040	0.0113
St. Dev.	0.0634	0.0560	0.0654	0.0554	0.0665	0.0591	0.0661	0.0537
Skewness	-0.1008	0.8963	-0.2512	0.6700	-0.2198	0.6284	-0.2475	0.5843
Kurtosis	5.1038	4.6869	5.9097	5.4030	5.6426	3.8858	5.6841	4.6784
Sharpe Ratio	-0.0634	0.0302	-0.0352	0.1031	0.0403	0.2094	0.0439	0.1885
Min.	-0.2039	-0.1066	-0.2200	-0.1183	-0.2157	-0.1074	-0.2151	-0.1042
Max.	0.1524	0.1428	0.1599	0.1529	0.1703	0.1450	0.1703	0.1434
Winner - Loser strategy								
Mean	-0.0446	-0.0191	-0.0378	-0.0207	-0.0314	-0.0072	-0.0300	-0.0098
St. Dev.	0.0597	0.0170	0.0641	0.0345	0.0604	0.0368	0.0583	0.0320
Skewness	-3.3695	0.2243	-3.0292	-0.4876	-2.7701	0.4854	-2.8035	-0.7037
Kurtosis	17.7310	2.9695	15.7099	4.1063	14.5795	4.3144	15.1597	4.2027
Sharpe Ratio	-0.7651	-1.1773	-0.6068	-0.6300	-0.5367	-0.2240	-0.5323	-0.3396
Min.	-0.3342	-0.0477	-0.3363	-0.1083	-0.3084	-0.0786	-0.3010	-0.0938
Max.	0.0238	0.0192	0.0476	0.0467	0.0630	0.0899	0.0638	0.0430

Appendix 1 shows the summary statistics of the different portfolios created for the prior Return Momentum strategy since its start in 2008 until 2020, the table is split in three parts: the “losers” that are shown in the “Lowest percentile of the strategy”, the “winners” that are shown in the “Highest percentile of the strategy” and the portfolio created that is the section “Winner – Loser strategy”.

Appendix 2

Appendix 2

Relevant statistics for ESG Momentum Strategy

Formation period	3		6		9		12	
Holding Period	3	6	3	6	3	6	3	6
Lowest percentile of the strategy								
Mean	0.0009	0.0097	0.0004	0.0092	-0.0018	0.0083	-0.0018	0.0060
St. Dev.	0.0433	0.0354	0.0431	0.0350	0.0431	0.0357	0.0428	0.0349

Skewness	-1.1482	0.5593	-1.2250	0.5185	-1.2556	0.4665	-1.2554	0.5950
Kurtosis	6.9660	3.7017	6.8974	3.5987	6.7863	3.5637	6.7826	4.0552
Sharpe Ratio	-0.0037	-0.0037	-0.0160	0.2288	-0.0658	0.1984	-0.0665	0.1399
Min.	-0.1536	-0.0618	-0.1536	-0.0616	-0.1553	-0.0650	-0.1540	-0.0658
Max.	0.0950	0.0895	0.0866	0.0860	0.0850	0.0868	0.0853	0.0866
Highest percentile of the strategy								
Mean	0.0014	0.0063	0.0015	0.0063	0.0008	0.0054	0.0006	0.0048
St. Dev.	0.0369	0.0267	0.0371	0.0273	0.0369	0.0283	0.0373	0.0279
Skewness	-1.9152	0.0647	-1.8739	0.1890	-1.9286	0.0944	-1.9022	0.1689
Kurtosis	8.4362	4.7701	8.3442	4.8427	8.6350	4.7063	8.4572	4.8957
Sharpe Ratio	0.0073	0.1928	0.0102	0.1877	-0.0080	0.1486	-0.0140	0.1326
Min.	-0.1341	-0.0608	-0.1341	-0.0610	-0.1358	-0.0649	-0.1370	-0.0642
Max.	0.0569	0.0635	0.0579	0.0676	0.0597	0.0668	0.0597	0.0669
Winner - Loser strategy								
Mean	0.0004	-0.0033	0.0011	-0.0029	0.0026	-0.0029	0.0023	-0.0012
St. Dev.	0.0144	0.0146	0.0135	0.0140	0.0144	0.0140	0.0138	0.0128
Skewness	-0.6229	-0.9534	-0.1980	-1.0419	-0.0772	-1.0484	-0.2563	-0.5484
Kurtosis	4.1158	4.8750	2.8102	5.6020	2.8751	5.7541	2.5908	3.2167
Sharpe Ratio	-0.0461	-0.3036	-0.0015	-0.2858	0.1017	-0.2857	0.0900	-0.1791
Min.	-0.0440	-0.0445	-0.0321	-0.0444	-0.0289	-0.0447	-0.0295	-0.0322
Max.	0.0312	0.0215	0.0295	0.0206	0.0369	0.0193	0.0293	0.0206

Appendix 2 shows the summary statistics of the different portfolios created for the prior Return Momentum strategy since its start in 2008 until 2020, the table is split in three parts: the “losers” that are shown in the “Lowest percentile of the strategy”, the “winners” that are shown in the “Highest percentile of the strategy” and the portfolio created that is the section “Winner – Loser strategy”.

Appendix 3

Appendix 3

Performance of the double-sorted strategy in comparison with the benchmark

Formation Holding	3		6		9		12		Benchmark
	3	6	3	6	3	6	3	6	
Mean	0.0104	-0.0022	0.0076	-0.0131	0.0151	0.0099	0.0196	0.0015	0.0048
Standard Deviation	0.0530	0.0335	0.0593	0.0864	0.0776	0.0449	0.0841	0.0675	0.0470
% of portfolios that outperform the benchmark	53.85	50.00	58.97	54.55	58.97	54.55	61.54%	59.09	

Appendix 3 shows the comparison of mean and standard deviation between the double-sorted strategy and the benchmark, the table also includes the percentage of portfolios for each holding and formation period that outperform the benchmark.

Figure 1

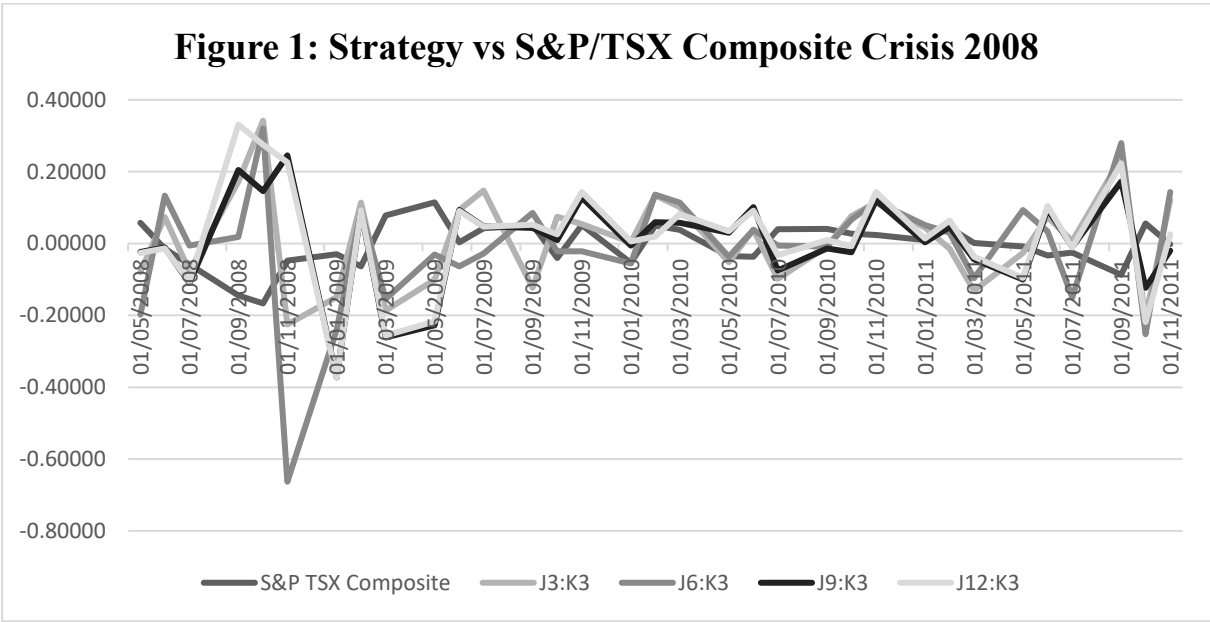


Figure 1 shows the comparison of the performance of the Canadian benchmark and the portfolios of 3 months holding of the double-sorted strategy. The dates selected for this period was from April of 2008 until November of 2011.

Figure 2

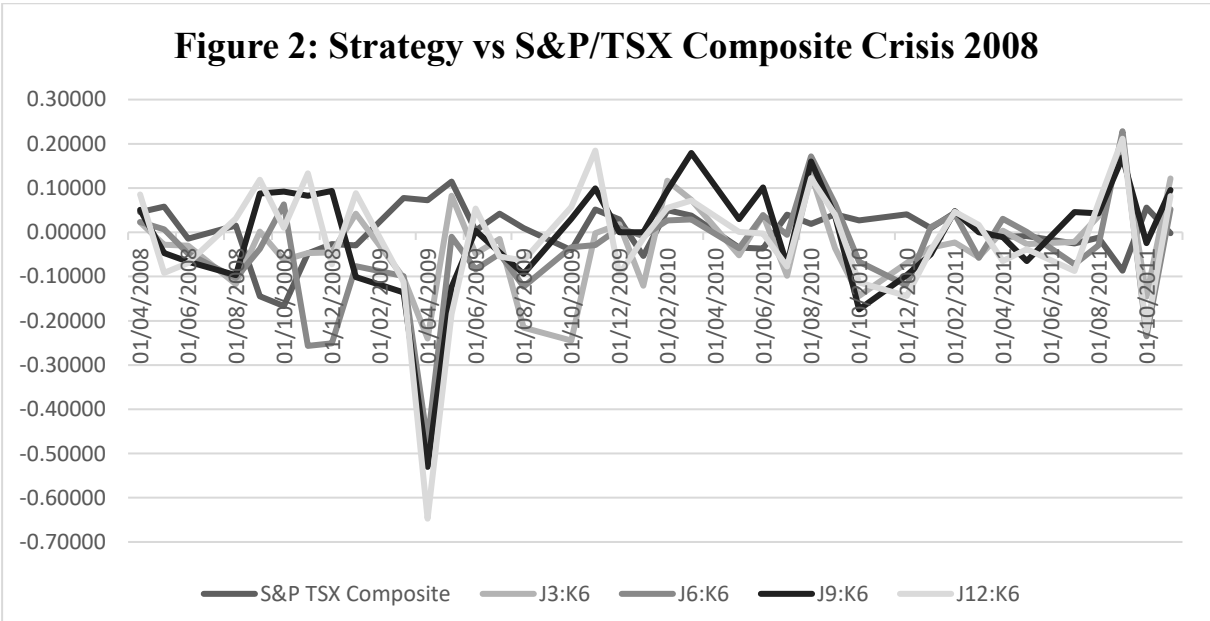


Figure 2 shows the comparison of the performance of the Canadian benchmark and the portfolios of 6 months holding of the double-sorted strategy. The dates selected for this period was from April of 2008 until November of 2011.

Appendix 4

Appendix 4

Results of the single factor momentum strategies for 2008 Crisis

Panel A: Prior Return Momentum

K =	3				6			
	J = 3	6	9	12	3	6	9	12
Volatility	8.36%	9.13%	8.84%	8.76%	4.89%	5.89%	6.49%	6.05%
Average Return	-0.0393	-0.0472	-0.0393	-0.0400	-0.0252	-0.0342	-0.0257	-0.0278
Minimum	-0.4153	-0.4803	-0.4351	-0.4263	-0.1481	-0.2205	-0.2233	-0.1950
Maximum	0.0876	0.0483	0.0930	0.0873	0.0746	0.0589	0.0551	0.0673

Panel B: ESG Momentum

K =	3				6			
	J = 3	6	9	12	3	6	9	12
Volatility	2.63%	2.75%	2.90%	3.14%	2.50%	2.56%	2.89%	2.96%
Average Return	-0.0037	-0.0033	-0.0030	-0.0029	-0.0066	-0.0063	-0.0068	-0.0065
Minimum	-0.0609	-0.0619	-0.0669	-0.0879	-0.0540	-0.0645	-0.0879	-0.0889
Maximum	0.0466	0.0466	0.0574	0.0733	0.0466	0.0480	0.0733	0.0779

Appendix 4 shows the mean, volatility, minimum and maximum of the single factor momentum strategies for the Crisis of 2008, the dates selected where from April of 2008 until November of 2011. The information is split in two panels, Panel A contains the results of the Prior Return Momentum strategy and Panel B contains the results of the ESG Momentum strategy.

Figure 3

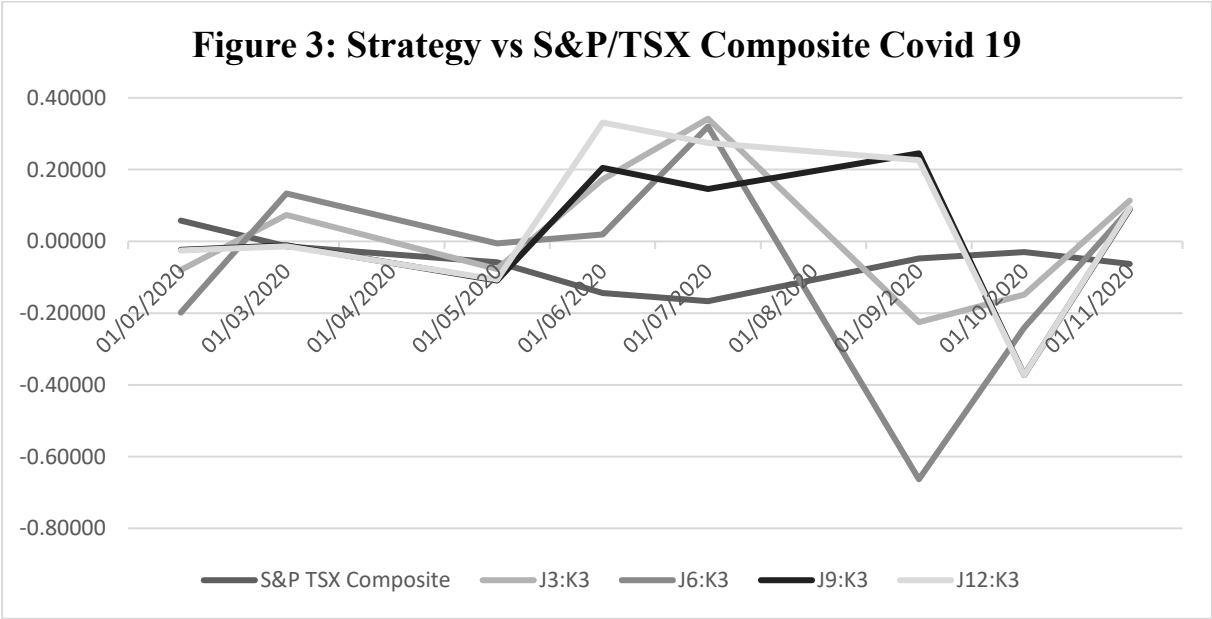


Figure 3 shows the comparison of the performance of the Canadian benchmark and the portfolios of 3 months holding of the double-sorted strategy. The dates selected for this period was from February of 2020 until November of 2020.

Figure 4

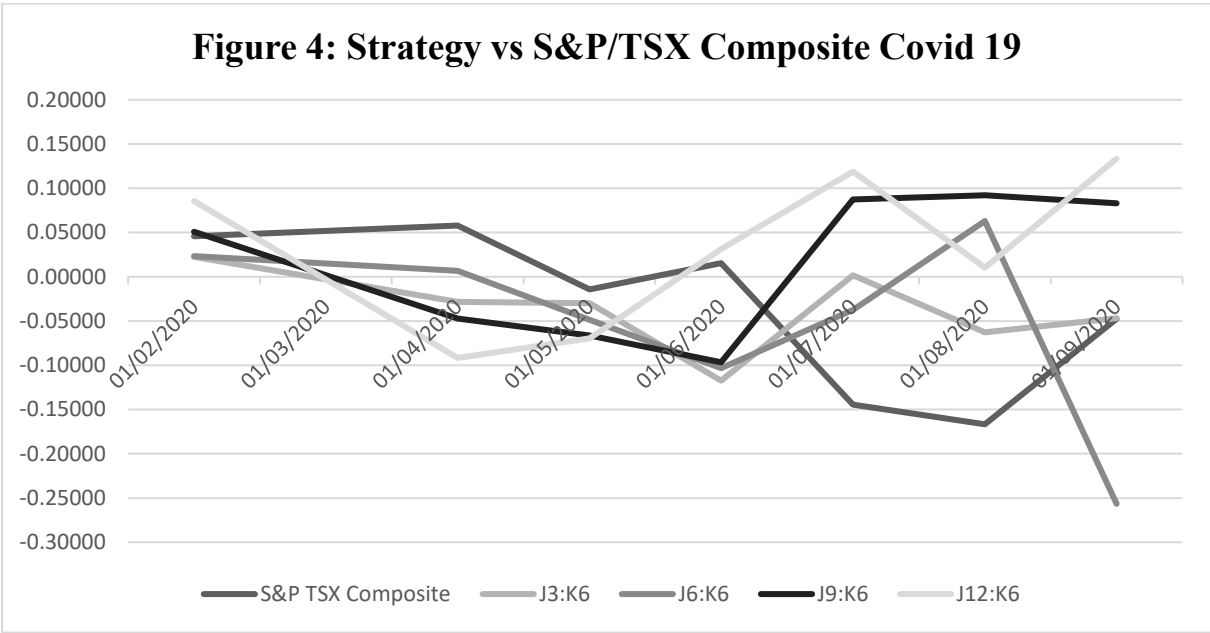


Figure 4 shows the comparison of the performance of the Canadian benchmark and the portfolios of 6 months holding of the double-sorted strategy. The dates selected for this period was from February of 2020 until November of 2020.

Appendix 5

Appendix 5
Results of single factor momentum strategies for Covid 19

Panel A: Prior Return Momentum								
K =	3				6			
J =	3	6	9	12	3	6	9	12
Volatility	5.69%	6.15%	4.43%	4.43%	9.07%	7.36%	8.07%	8.17%
Average Return	-0.0401	-0.0367	-0.0395	-0.0395	-0.0073	-0.0109	-0.0076	-0.0107
Minimum	-0.1243	-0.1256	-0.1237	-0.1237	-0.2068	-0.1699	-0.1694	-0.1917
Maximum	0.0575	0.0487	0.0208	0.0208	0.0561	0.0448	0.0689	0.0453

Panel B: ESG Momentum								
K =	3				6			
J =	3	6	9	12	3	6	9	12
Volatility	3.76%	3.21%	2.91%	2.96%	3.29%	2.83%	2.87%	2.83%
Average Return	-0.0182	-0.0142	-0.0152	-0.0158	-0.0257	-0.0212	-0.0225	-0.0223
Minimum	-0.1008	-0.0853	-0.0808	-0.0819	-0.0909	-0.0764	-0.0783	-0.0774
Maximum	0.0209	0.0209	0.0106	0.0121	0.0079	0.0079	0.0090	0.0086

Appendix 5 shows the mean, volatility, minimum and maximum of the single factor momentum strategies for the Covid 19 crisis, the dates selected where from February of 2020 until November of 2020. The information is split in two panels, Panel A contains the results of the Prior Return Momentum strategy and Panel B contains the results of the ESG Momentum strategy.

Appendix 6

Appendix 6

Average number of trades per double sorted portfolios

Formation	3		6		9		12	
Holding	3	6	3	6	3	6	3	6
Trades at formation	32	32	38	38	29	29	27	27
Average number of trades between portfolios	69	68	55	63	44	54	43	48

Appendix 6 shows the number of Trades at formation (total number of stocks bought or sold to create the different portfolios) and the Average number of trades between portfolios, this variable indicates on average how many stocks are bought or sold to go from one portfolio to another according to the double-sorting.