Pairs trading in Canadian markets: Pay attention to inattention

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ABSTRACT

We document that pairs trading can be an effective return-enhancement strategy in Canadian markets. It is most effective in volatile markets when investor attention becomes strained.

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1. Introduction

Arbitrage opportunities exist when profits can be earned from spread trading, the simultaneous purchase and sale of similar securities. A trader buys the one that she believes is relatively cheap while shorting the relatively expensive security – in the hope that the spread will narrow. Assuming that her views are well-founded, losses can still result, in part because of what the academic finance literature puts under the rubric "limits to arbitrage." Assuming reasonable liquidity levels, these limits stem from two sources of risk: fundamental risk and noise trader risk. The first exists if the long and short sides of the spread are not perfect substitutes (as is almost always the case). For example, if you think Ford is cheap relative to GM, a long Ford-short GM arbitrage could founder because unanticipated negative Ford-specific (i.e., unrelated to the broad auto industry) news is announced.

Noise trader risk, defined to be the risk that mispricing becomes worse in the short run, has been famously documented by Lamont and Thaler (2003) with the Royal Dutch/Shell case. At one time Royal Dutch, headquartered in the Netherlands, and Shell, based in the U.K., were two totally distinct companies. Their association began in 1907, but this association fell short of a full merger. Using what is known as a dual-listed company structure, Royal Dutch and Shell merged all of their operations, agreeing on an ownership of 60% for Royal Dutch and 40% for Shell for their subsidiaries. All after-tax cashflows, including dividend payments, were electively split in the proportion of 60:40. Despite the fact that this was common knowledge to all shareholders, their share prices, amazingly, often were well out of synch with this ratio, with researchers finding persistent and large price deviations of up to 35% away from parity. Since the dual-listed status made it clear that Royal Dutch and Shell were perfect substitutes, the mispricing that was observed was logically the result of noise trader risk.[1]

This case notwithstanding, in most realistic arbitrage situations *both* fundamental risk and noise trader risk are factors. Say we believe that two "similar" securities, though not perfect substitutes for each other, are out of alignment. Assembling zero-cost portfolios of such perceived mispriced pairs of securities for diversification purposes may be the solution. In this context Gatev, Goetzmann and Rouwenhorst (2006) first documented the efficacy of pairs trading, a quantitative strategy that has existed on Wall Street for over 25 years. While it made sense that Royal Dutch and Shell should move together, what if we don't worry about obvious commonalities between securities but rather let the data do the talking? Pairs trading involves the exhaustive (computer-assisted) search for pairs of securities that have moved closely together (say) over the last year. On the expectation that this pattern will continue to hold for at least the next several months, a pairs trade is put into practice when a divergence of sufficient magnitude is observed. The cheap security is purchased while the dear security is shorted in the expectation that the two stocks will move back together. Amazingly this simple strategy has worked quite well in the U.S., with a simple trading rule yielding 11%/year for self-financed portfolios of pairs.

Jacobs and Weber (2012) have recently extended this work in two important directions. First, they show that pairs trading is more profitable when market participants are likely to be inattentive. Attention is a scarce resource: it is not possible for everyone to be focusing on all information at the same time. People naturally prioritize, paying attention to what seems most important at the moment before shifting attention elsewhere. When executing a left turn a wise driver will postpone the philosophical debate he is having with his passenger until the turn is completed. It has been argued

[1] In 2004 Royal Dutch/Shell announced plans for a full merger (which it followed through with in 2005), partly as a result of persistent parity deviations. See de Jong, Rosenthal and Van Dijk (2009).

elsewhere that investors may reduce their attention to individual securities when an abundance of market-wide or sector-specific information arrives (Peng and Xiong (2006)). Jacobs and Weber develop a "distraction" metric based on this notion, and then go on to show that on days when distraction is highest pairs trading is most profitable.

Second, they extend their empirical analysis to the international realm by investigating the efficacy of pairs trading in Japan, the U.K., France, Germany, Switzerland, Italy, the Netherlands and Hong Kong. These markets represent the eight largest non-North American stock markets by capitalization. They find that pairs trading is profitable in all eight, with profits ranging from 6%/year (Italy) to 13%/year (Germany and France). Further, with the exception of Japan, distraction predicts the profitability of pairs trading as was true with U.S. data. The purpose of the present paper is to explore whether pairs trading is an effective return-enhancement strategy in Canada. To preview, the answer is in the affirmative, especially when markets are likely to be inattentive.

2. Methodology and results

To assess the efficacy of a pairs trading strategy, we first need to identify which pairs to potentially trade over a given trading period. We then must track returns over this trading period. Pairs are selected based on their return co-movement over a formation period spanning the previous 12 months, and trading occurs over the subsequent six.[2] Specifically, a cumulative total return index is constructed for each stock in our universe. All stocks are matched against all other stocks to form potential pairs with the sum of the squared deviations between the two normalized unit values being calculated for each pair. The pairs judged to exhibit the highest degree of co-movement

[2] To obviate the criticism of data snooping, we initially follow to the letter the methodology of Gatev, Goetzmann and Rouwenhorst (2006). They for example use the same 12-month formation/6-month trading periods. Moreover we use the same top-5 and top-20 strategies (as discussed later in this section).

are those with the lowest sums of squared deviations.[3] While there are thousands of potential pairs, we restrict ourselves going forward to either the top-5 or top-20 pairs in terms of the degree of co-movement.

Trading in identified pairs is undertaken over the subsequent six months beginning the day after selection. Our approach is to track all selected pairs (whether the top-5 or top-20) under consideration and, if and when a sufficient divergence (of the normalized dividend-adjusted prices) appears, to initiate a pairs trade, keeping it open till convergence occurs.[4] "Sufficient" is deemed to be when a divergence of more than two historical standard deviations of the normalized dividend-adjusted price spread (based on the formation period) has been opened up. If convergence never occurs, the pairs trade is held open till the end of the 6-month trading period with closure only occurring on the last day. Note that each pair can open and close on several occasions during a six-month period.

Figure 1 provides an example of pairs trading. The two securities are the Royal Bank of Canada (RY) and First Capital Realty (FCR), which were selected for trading during June-November 2008 (comprising a total of 126 trading days). Notice that this pair opens and closes three times. By day 9, FCR is dear relative to RY, so the latter is bought and the former shorted. On day 46, convergence occurs and the position is closed. Next, on day 48, the position is re-opened, again long RY and short FCR, with closure taking place on day 63. Finally, by day 78 RY has become dear relative to FCR, so the latter is bought and the former shorted. This position remains open until the end of the 6-month period, and is then closed. Note that this pair opens and closes three times: the first open-close trade offers a 7.04% return, the second yields 5.71%, and the third (which closes at the end of the 6-month period without convergence) loses 0.37%. In total, the compounded return during the six-month trading period is 12.73%.

[3] Baronyan, Boduroglu and Sener (2010) explore various other procedures.
[4] Convergence of a pair is said to occur when the normalized price of the stock bought exceeds (or is identical to) that of the stock shorted.

Our data run from July 1983 to December 2011. Since a 12-month formation period is used, pairs trading is opened up for the first time in July 1984. We use all publicly traded Canadian firms both with stock return data appearing in the Canadian Financial Market Research Centre database and with accounting data appearing in Compustat.[5] Passing this double screen are 2,723 securities. Securities that do not trade on all days during the formation period are dropped from consideration. This leaves between 76-518 stocks to be potentially included in 2,850-133,903 pairs, with average annual market capitalization ranging from \$500 million to \$1.9 billion.

Excess returns on each selected pair are gains to the long position net of gains to the short position. Matters are complicated at the portfolio level (made up of top-5 or top-20 pairs) by the fact that not all pairs are always open. Formally, daily returns to a pairs portfolio are calculated as the following weighted average returns of its constituent pairs:

$$(1)\ R_{P,t} = \frac{\sum_{i \in P_{open,t}} w_{i,t} R_{i,t}}{\sum_{i \in P_{open,t}} w_{i,t}}$$

$$(2)\ w_{i,t} = w_{i,t-1}\left(1 + R_{i,t-1}\right) = \left(1 + R_{i,1}\right) \dots \left(1 + R_{i,t-1}\right)$$

where $R_{i,t}$ is the return of pair *i* at *t*, $w_{i,t}$ is the corresponding weight, and $P_{open,t}$ denotes the subset of pairs within the pairs portfolio that remain open at month *t*. For example, say in a particular month only 11 out of the 20 selected pairs making up of the top-20 pairs portfolio remain open. To evaluate $R_{P,t}$ for that month, we calculate the weighted average returns of the 11 opened pairs based on Equation (1).[6] In adopting this approach, we are in effect assuming that the capital that has not been utilized by the nine closed pairs is being redeployed to increase the exposures on the 11 pairs that

[5] We exclude trusts and units, and thus only consider ordinary common shares.
[6] Gatev, Goetzmann and Rouwenhorst (2006) call this the "fully invested return."

remain open. Also note that, by computing the weight according to Equation (2), we can interpret $w_{i,t}$ as the wealth accumulated from excess returns generated by pair i up to month t if we started with a notional value of \$1 at the beginning of the 6-month trading period.

The procedure is to identify new pairs every month, with the intention of potentially trading them for the next six. This means a second pairs "portfolio" (made up of either top-5 or top-20 pairs) opens up for trading August 1984. The selection of the constituent pairs is based on the second formation period from August 1983 to July 1984. Subsequent pairs portfolios are formed/traded in a similar fashion on a monthly basis according to the rolling 12-month formation/6-month trading window. Since trading occurs for six months, once five months have elapsed six pairs portfolios will be trading, resulting in a time series of overlapping trading excess returns. As in Jegadeesh and Titman (1993), correlation induced by overlap is eliminated by averaging monthly excess returns across the six portfolios.

Table 1 documents that returns to pairs trading in Canada would have been substantial. Beginning with Panel A, trading based on the top-5 pairs would have garnered a highly significant 2.46%/month, while trading based on the top-20 would have generated 1.53%/month. Though the return from trading more pairs is lower, its standard error given the greater scope for diversification is also markedly lower. For robustness, we consider in the second row the more conservative "return on committed capital," which also includes the (zero) returns from the closed pairs in evaluating the weighted average portfolio return. In other words, we calculate the weighted average of Equation (1) by including all 5 (20) pairs in the 5-pair (20-pair) portfolio regardless of whether the pairs are closed or opened during a particular month. When one takes a committed capital approach, returns are now 1.37% (top-5) and 0.71% (top-20). Annual compounding puts top-5 returns in the 17.7-33.9% range on average, which is within the range found in pairs trading studies in other major markets.

Panel B provides additional information on the excess return distribution based on the fully invested approach. Noteworthy is the fact that (monthly) excess returns are negative between 20.6-23.0% of the time, which suggests that pairs trading can be unprofitable for short periods of time. With this in mind it is incumbent upon us to consider the stability of pairs trading profitability. That is, does the strategy hold up well over time, or is its success restricted to only certain subperiods? If profitability is sometimes high and at other times low and undependable, managers are more likely to look favorably on strategies that have performed well in the *recent* past compared to those which have mostly contributed alpha in the more distant past. For this purpose we divide the sample into three equal subperiods. Panel C shows that the strategy has consistently generated positive excess returns over time, with both the top-5 and top-20 strategies leading to significantly positive results during each subperiod.

Can risk account for these findings? If there is a tendency for exposures to risk factors to differ for the long and short positions of pairs then this could be an issue. We use the now-conventional Fama-French (1993) three-factor model to broach this issue. According to this model, the alpha (α^P) of a pairs portfolio can be estimated by running the following regression, in which we control for market, firm-size and book-to-market factors:

$$(3)\quad R_{P,t} = \alpha^P + \beta_1^P\left(R_{m,t} - R_{f,t}\right) + \beta_2^P SMB_t + \beta_3^P HML_t + \varepsilon_t^P$$

where the 30-day return on Canadian T-bills is $R_{f,t}$, the market return (using the S&P/TSX Composite Total Return Index) is $R_{m,t}$, the size factor is SMB_t and the book-to-market factor is HML_t.[7]

In Panel D, we present the Fama-French 3-factor risk adjustment results for the fully invested pairs portfolio returns. It is clear that risk adjustment does not attenuate the

[7] We constructed SMB_t and HML_t, as in Deaves and Miu (2007).

strength of pairs trading profitability. All risk exposures (i.e., β_1^P, β_2^P, and β_3^P) are insignificantly different from zero, which means that long and short exposures are on average roughly equal in terms of systematic risk. Further, the alpha (α^P) is very close to its raw return level (as reported in Panel A) and remains highly statistically significant.

3. Transaction costs and cumulative profitability

To operationalize a trading-intensive strategy of this type, it is important to consider transaction costs. Thapa and Poshakwale (2010) provide total transaction cost data for a group of markets including Canada. These costs, which include commissions, fees and market impact, are the average total magnitudes faced by institutional investors during 2001-2006.[8] For Canada the average cost per transaction is 32.35 basis points. Based on this value, we conduct a simulation for 2000-2011, using the previously described top-5 committed capital approach, which has the advantage of minimizing transaction costs. Further, we restrict ourselves to the top 50% of firms by market capitalization in our sample, with annual averages ranging from $1.4-3.7 billion. This, coupled with the condition that all firms must trade every day during the one-year formation period, ensures a level of liquidity that is very likely sufficient to obviate short-selling restrictions.[9] Figure 2 shows that, even in the presence of such transaction costs, pairs trading remains profitable. To interpret, we begin with $1 invested in the market at the end of 1999 and going forward continue to invest in the market while engaging in pairs trading. Leverage is controlled by at most taking on a pairs trading exposure equal to the portfolio value which may grow over time both because of the return on the market and to the extent that pairs trading is profitable. While the portfolio grows for both of

[8] These transaction cost data were originally obtained from the firm Elkins/McSherry.

[9] Deaves and Miu (2007) argue that in the case of short-selling non-availability was very unlikely to be an issue for the most liquid Canadian stocks. Moreover, the loss of short-sale proceeds is rarely significant unless a security is "special" (note that such a security has, when lent, because of scarcity, a lower than average interest rebate going to the borrower), and highly liquid stocks are very unlikely to be in this category.

these reasons, the figure captures that component which is due to pairs trading. The average compounded excess return during 2000-2011 was equal to 16.45%/year.[10]

The use of 32.35 basis points is appropriate if the reported closing prices that we use are mid-market, or if they are at the bid 50% of the time and at the ask 50% of the time. In reality, because of the so-called bid-ask bounce (Jegadeesh (1990)), there are reasons to believe that we are usually on the wrong side of the close. For this reason, we also report in Figure 2 cumulative returns for transaction cost assumptions of 48.53 and 64.70 basis points. The latter is predicated on the extreme condition that if we want to go long in A and short in B the reported price for A is always the bid and the reported price for B is always the ask. Even with more conservative transaction costs assumptions, cumulative excess returns still remain positive.[11] Assuming 48.53 basis points, the average compounded excess return over 2000-2011 is 11.7%/year, while under the most conservative of transaction cost assumptions it is 6.6%/year.

4. When is profitability highest?

Variability over time in profitability is suggested by the twists and turns revealed in Figure 2. Figure 3 provides average annual after-transaction cost excess returns on a yearly basis during 2000-2011.[12] Without doubt there is substantial variability on a year-to-year basis. In three of the 12 years (2006, 2007 and 2011) under the most conservative of transaction costs assumptions pairs trading is downright unprofitable. It is quite salient that overall pairs trading profitability is driven by 2008-2009: even

[10] We stop the simulation mid-way through 2011 because after this point not all of the six pairs portfolios are still trading.
[11] Gatev, Goetzmann and Rouwenhorst (2006) do not explicitly incorporate transaction costs, but instead invoke conservatism through their "one day wait" rule, which stipulates that transactions are done both a day after divergence and a day after convergence. We repeat this procedure and present the results in the third row of Panel A of Table 1.
[12] For 2011, the six-month return is annualized.

with 64.70 basis point transaction costs it remains very profitable.[13]

Consider prevailing economic conditions and the state of financial markets during 2008-2009. Much of the worst of the global financial crisis that roiled markets and that remains a painful memory to many occurred during this span. Both of these years experienced very high levels of volatility (with both years falling in the top three years in volatility over the sample). And while 2009 witnessed a significant market recovery, 2008 was by far the poorest market year over the sample. Consistent with the argument of Jacobs and Weber (2012), when conditions of a macro nature (whether market-wide or at the level of the industry) are turbulent, less attention is accorded firm-specific information and price spreads between ″similar″ securities can widen. Moreover, though the evidence is weaker here, a là an "ostrich effect," there may be a tendency for investors to lose focus when markets decline (Karlsson, Loewenstein and Seppi (2009)). The lesson seems to be: pay most attention when others stop doing so.

[13] Pairs are sometimes made up of two classes of the same security. This is particularly true in 2008 and 2009.

TABLE 1: Excess Returns (per month) from Pairs Trading

Panel A: Monthly average excess returns for full sample		
	Top 5	**Top 20**
Average excess return (fully invested)	0.0246 (0.000)	0.0153 (0.000)
Average excess return (on committed capital)	0.0137 (0.000)	0.0071 (0.000)
Average excess return (one-day waiting)	0.0056 (0.000)	0.0077 (0.000)
Panel B: Monthly excess return distribution for full sample		
	Top 5	**Top 20**
Median	0.0157	0.0129
Standard deviation	0.0478	0.0233
Skewness	3.409	1.457
Kurtosis	17.185	5.130
Minimum	-0.1029	-0.0594
Maximum	0.3467	0.1335
Negative excess return %	20.61%	23.03%
Panel C: Subperiod analysis (fully invested)		
	Top 5	**Top 20**
Subperiod 1 1984:7-1993:8	0.0132 (0.000)	0.0115 (0.000)
Subperiod 2 1993:9-2002:10	0.0242 (0.000)	0.0150 (0.000)
Subperiod 3 2002:11-2011:12	0.0364 (0.023)	0.0186 (0.002)
Panel D: Fama-French 3-factor model		
	Top 5	**Top 20**
Intercept (α^P)	0.0248 (0.000)	0.0156 (0.000)
Market (β_1^P)	-0.072 (0.645)	-0.047 (0.404)
SMB (β_2^P)	0.139 (0.230)	0.017 (0.722)
HML (β_3^P)	-0.024 (0.782)	-0.019 (0.586)
R-squared	0.0144	0.0078

NOTE: Where appropriate, p-values are reported in brackets.

FIGURE 1: Example of Pairs Trading – Royal Bank of Canada and First Capital Realty

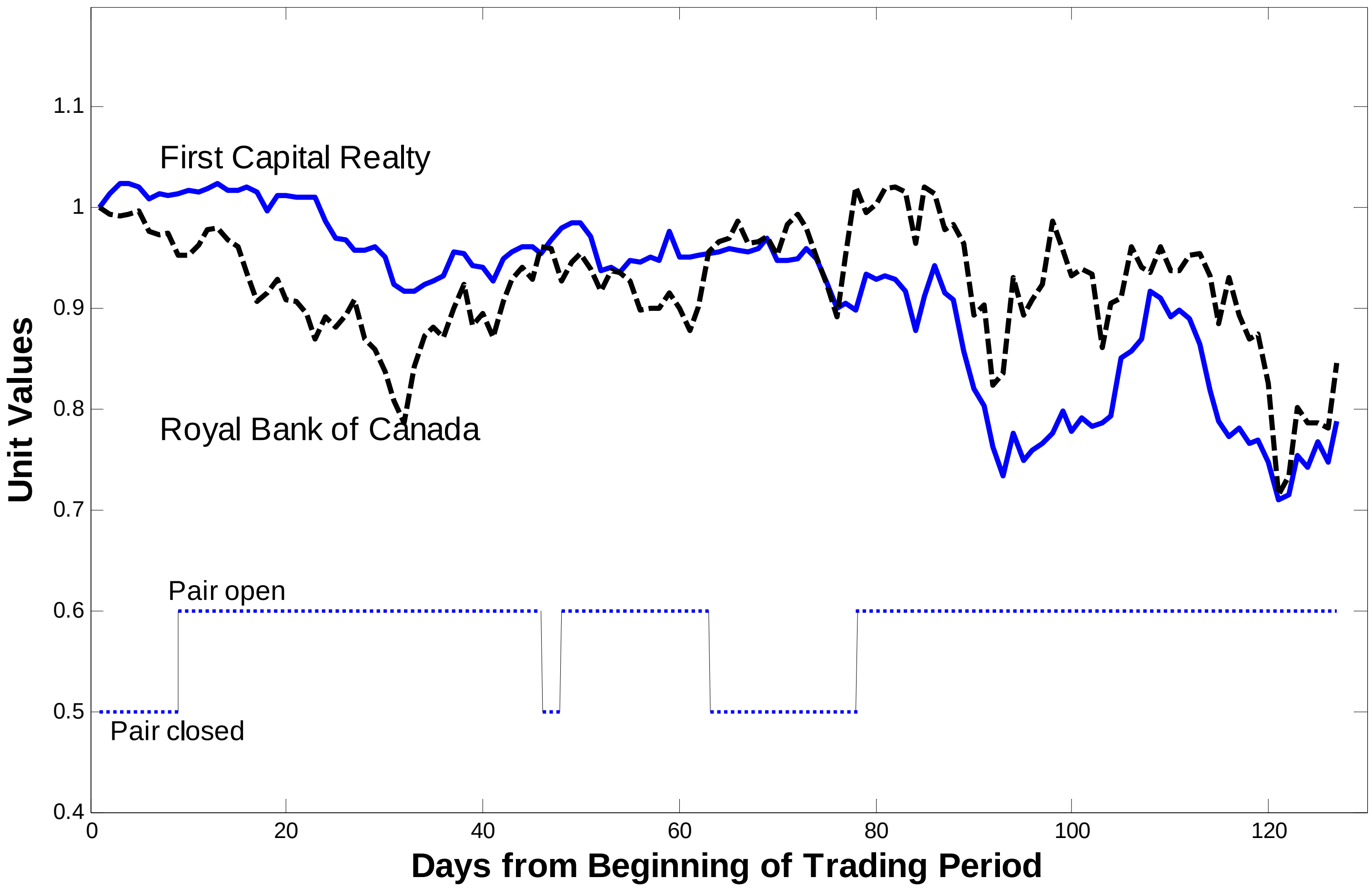


FIGURE 2: Cumulative Excess Return after Transaction Costs from Top-5 Pairs Trading during 2000-2011

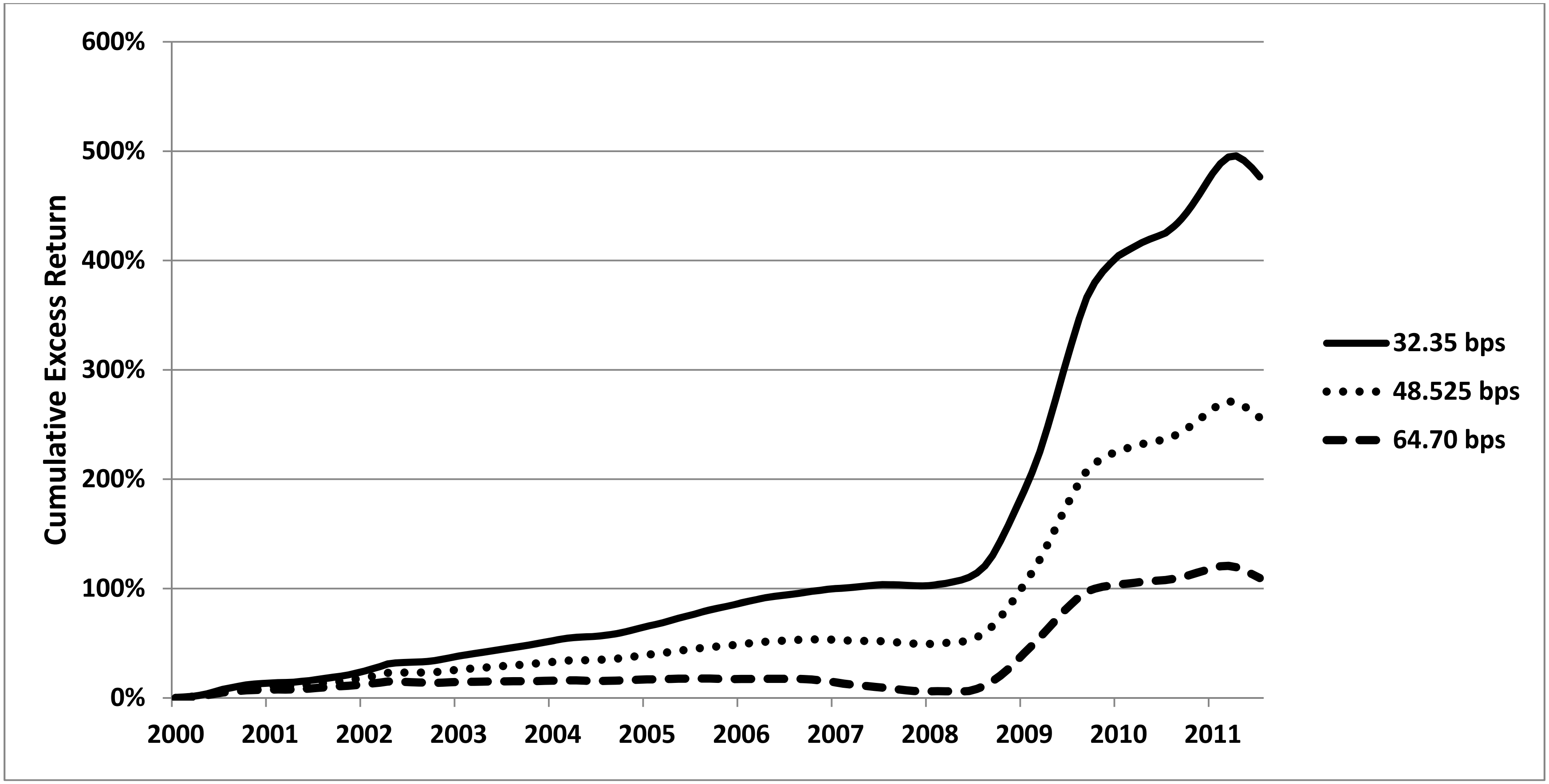
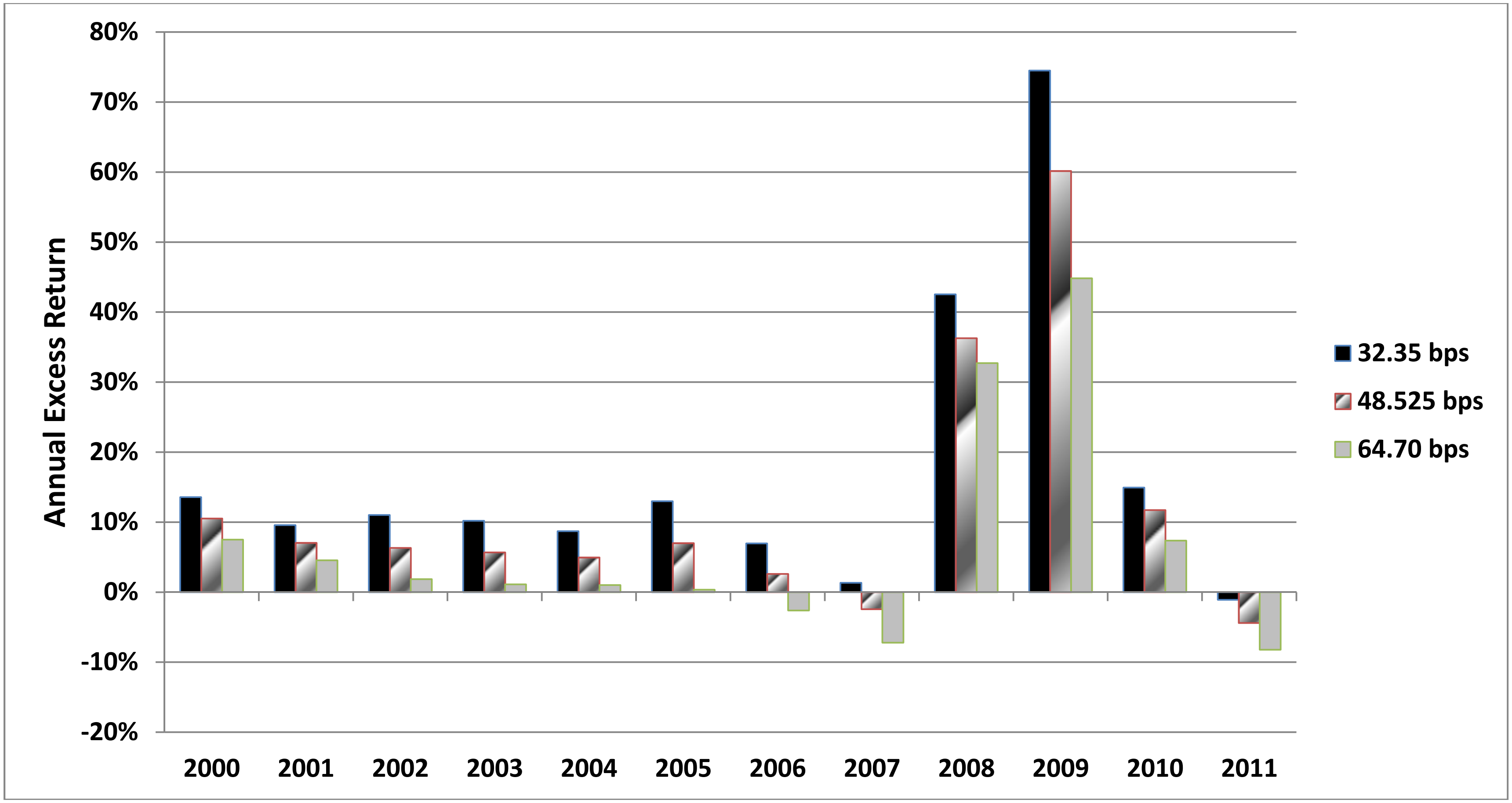


FIGURE 3: Average Annual Excess Returns from Top-5 Pairs Trading after Transaction Costs during 2000-2011



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