

**PERFORMANCE, PERSISTENCE AND SURVIVORSHIP
BIAS OF CANADIAN EQUITY FUNDS 2001-2005**

by

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Abstract

This study investigates the performance of Canadian equity funds over a 5-year period. I use a dataset consisting of monthly returns from all equity funds existed at any point from June 2001 to December 2005, which enables me to observe more precisely the performance and the extent of survivorship bias. Consistent with what has been addressed by the literature using US data, the sample shows that Canadian equity funds underperform the market benchmark on average over the study period. In addition to the contingency table approach, an ordered probit model is introduced to assess the predictability of fund past performance based on quartile rankings. I find evidence that good/poor performers are likely to persist only over a short-term horizon and not over a medium-term horizon. If the existence of load fees and sales fees is ignored, chasing top funds year by year seems to be a reliable investment strategy.

Keywords:

Canadian equity funds, Performance, Persistence, Survivorship bias

Dedication

谨献给我亲爱的父母

To My Parents

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1. Introduction

Even though mutual funds have been around since the 1920s in Canada, the sales of mutual funds did not really take off until the decline of interest rates in the 1990s. There are currently over 2,000 mutual funds available to investors in Canada. The total assets in the Canadian mutual fund industry have increased from \$24.9 billion in 1990 to \$539 billion as of October 31, 2005.¹ Mutual funds have received increasing attention from academia and investors. Since mutual funds are managed by experienced professionals, they are supposed to deliver higher returns to investors. While many do, some do not. According to the rankings of *Morningstar*, as of October 31, 2005, the three-year annualized return of the best-performing fund was as high as 132.9%, whereas the three-year annualized return of the worst-performing fund was as low as -32.6%.² Therefore, when it comes to choosing a mutual fund, an investor needs to know what is the probability that a fund will outperform the average. To demonstrate their ability in generating high returns, fund managers often rely on their past performances. The central issue is, “Can past performance forecast the future profitability of a mutual fund?” “Can a fund’s performance be consistently above (or below) the average performance for a group of similar funds?” In other words, “Is the fund’s performance persistent?”

The efficient markets hypothesis assumes that financial market prices can fully reflect available information and hence an uninformed investor can earn returns

¹ www.stockhouse.ca

² www.morningstar.ca

equivalent to those obtainable to the experts. However, in the real world, professionally managed mutual funds proclaim their abilities of earning superior returns based on their private information and use the records of past performance to predict their future performance. To resolve this apparent contradiction, a great volume of empirical works starting with Jensen (1968) has investigated the performance of mutual funds. Jensen used “Jensen’s Alpha” to assess the risk-adjusted returns of mutual funds during the period 1945-1964 against the benchmark of S&P 500 Index. He concluded that not only was average fund performance not better than that predicted, but neither was individual fund performance, and there was no evidence of persistence.

There is an extensive academic literature on evaluating fund performance based on different asset-pricing models and benchmark choices. However, the subject is complicated and outside the scope of this study, in which we place greater emphasis on the issue of performance persistence.

Earlier studies have failed to find persistence in superior performance through time [see McDonald (1974), Shawky (1982), Chang and Lewellen (1984), Grinblatt and Titman (1989), and Ippolito (1989)]. However, studies from the early 1990s tend to indicate that persistent superior performance exists for some funds by employing more recent datasets against a variety of benchmarks. Hendriks, Patel, and Zeckhauser (1993) find evidence for persistence in mutual fund performance for the next two to eight quarters. Goetzmann and Ibbotson (1994) find persistence for the next three-year periods. Brown and Goetzmann (1995) find one-year persistence for the best performed and the worst performed mutual funds, but they find that the average funds are not predictive. Carhart (1997), Danel, Grinblatt, Titman, and Wermers (1997), and Wermers (2000) find

performance persistence for the short-term period. Those authors who find evidence of persistence in mutual fund performance over short-term horizons of one to three years seem to agree that the performance persistence can be attributed to the “hot hands” phenomenon³ or the active use of momentum strategies⁴ by mutual fund managers.

On the other hand, Grinblatt and Titman (1992) and Christopherson, Person and Glassman (1998) find the existence of performance persistence in mutual funds over longer horizons of five to ten years, and attribute this to fund managers’ experience or stock-picking talent.

When it comes to interpreting the existence of performance persistence, two main issues have been questioned over time. First, survivorship bias leads to overestimation of persistence. Brown, Goetzmann, Ibbotson, and Ross (1992), Brown and Goetzmann (1995), and Malkiel (1995) find that survivorship bias in the mutual fund samples under study. Survivorship bias arises because some funds disappear during the period of study. Those funds may close or merge, and the information on them may become unavailable. Since being a survivor depends on past performance, the high return funds will tend to be over-represented in the sample and this may lead to bias in the predictability of past performance. Second, an inappropriate choice of performance benchmarks will give rise to false evidence of persistence. Carhart (1997) constructs a four-factor model to test persistence. He finds that superior stock-picking skill is attributable to the one-year momentum strategy. After controlling the one-year momentum factor, evidence of superior persistence in performance disappears. Wermers (1997) also confirms that the

³ Hendriks, Patel, and Zeckhauser (1993) call “hot hands” funds delivering sustained short-run superior performance.

⁴ As mentioned by Grinblatt, Mark, Sheridan Titman, and Russ Wermers (1995), the simple momentum strategy consists of buying past winners and selling past losers. This strategy would generate abnormal performance before transaction cost.

continued use of momentum strategies by fund managers accounts mostly for performance persistence. After taking account of portfolio characteristics by a portfolio-based measurement benchmark, apparent fund persistence disappears.

In conclusion, previous academic studies do sometimes find performance persistence in the mutual fund industry. It is more common to find persistence in the short-term (one to two years) than in the medium or long term. Also, the majority of studies seem to agree that bad past performance increases the probability of future bad performance.

However, most studies have used data from the U.S. mutual fund industry and the way of measuring performance persistence is based on the contingency-table-based (non-parametric) method. Some recent studies [see Brown and Goetzmann (1995), Carhart (1997) and Christopherson, Person and Glassman (1998)] have adopted regression-based (parametric) methods using linear least square regression. In this paper, a data set of Canadian equity mutual funds for 2001-2005 is carefully constructed by the author to avoid survivorship bias. An ordered probit model is introduced to assess the predictability of past performance. The sample shows that Canadian equity funds underperform the market benchmark on average over the study period. Persistence analysis provides evidence that good/poor performers are likely to persist only over a short-term future and not over a medium-term future. Additionally, when markets experience fluctuations, the short-term persistence is broken down, which may imply that the less the persistence the more volatile the market.

This paper is organized as follows. Section 2 describes the data set employed in this paper. Survivorship bias is examined by comparing the average monthly returns of

different fund datasets over the five-year period. In Section 3, the performance of the universe of equity mutual funds is closely investigated using the one-factor CAPM model. This study tends to confirm the original argument that mutual fund managers do not outperform the market in general. In Section 4, the persistence of equity funds performance is examined in two ways — a contingency table analysis and an ordered probit regression. The methodology of ordered probit model is discussed in this section followed by empirical results. In Section 5, we then simulate investment strategies based on the evidence of persistence suggested in the literature. Section 6 concludes the paper.

2. Data and Survivorship Bias

The data of Canadian equity funds used in this paper are obtained from The Globe and Mail⁵ online monthly reviews for the 55-month period from June 2001 to December 2005. One important feature of The Globe and Mail monthly reviews is that they do not discard information on defunct funds once they have first incepted. Therefore, it is possible to avoid survivorship bias by tracking all funds for as long as they exist.

Our dataset includes a total of 1287 Canadian Equity funds. For each fund, we record the name, the month of inception, the month of decess (if any), the net asset value at the end of the year, the monthly return rates⁶, and the year-end management expense ratio (MER). To measure the average monthly returns of all funds, a fund is defined as “active” in a given year if it existed continuously for the entire year. Thus, 166 out of 1287 funds are dismissed since those funds have not existed over a whole calendar year.⁷ For instance, fund A was incepted in October 2001 and ceased in November 2002. Since it did not survive for a calendar year, neither 2001 nor 2002, it is discarded from the sample even though it survived for 13 months.

Table 1 reports the equally-weighted and value-weighted mean monthly returns for the whole sample for the entire 55-month period. Then we compare the mean monthly returns for funds that survived until December 2005 with all funds in existence as well as with those funds that did not survive. In column 1, we calculate the number and the

⁵ www.globefund.com

⁶ All return rates are calculated after the deduction of management fees and expenses.

⁷ Generally, investors rate funds based on their performance of a given calendar year. Yearly sampling makes performance analysis perceptible but inevitably causing slight survivorship bias.

Table 1. Summary Statistics for Equity Funds

This table reports the equally-weighted and value-weighted mean monthly returns for the whole sample and compares the mean monthly returns of funds that survived until December 2005 with those of nonsurviving funds for each year.

Year	Total Funds in Existence		Funds Surviving Until Dec-05		Funds that Did Not Survive Until Dec-05		S&P/TSX Composite Index			
	Mean Monthly Return (%)	Number	Mean Monthly Return (%)	Number	Mean Monthly Return (%)	Number				
2001	EW	-0.3922	383	-0.3476	177	-0.4304	206	1.36	53.79	-0.7288
	VW	-0.2262		-0.1146		-0.4635		1.32		
2002	EW	-1.0188	424	-0.9658*	218	-1.0748*	206	1.74	48.58	-1.1735
	VW	-0.874		-0.7745*		-1.1560*		1.90		
2003	EW	1.554	383	1.5100**	258	1.6447**	125	-2.32	32.64	1.8617
	VW	1.5415		1.5416***		1.5414***		-3.78		
2004	EW	0.9717	638	0.9764	445	0.9610	193	0.48	30.25	1.0128
	VW	0.9261		0.9277***		0.9185***		-5.07		
2005	EW	1.3065	478	----	---	---	---	---	----	1.7215
	VW	1.2961		---	---	---		---		

Note: EW represents equally-weighted and VW represents value-weighted.

T-test is for the hypothesis that the difference is zero between mean monthly returns of surviving and nonsurviving funds.

*denotes statistically significant at 10% significance level.

** denotes statistically significant at 5% significance level.

*** denotes statistically significant at 1% significance level.

mean monthly returns for all funds in existence for a given year. The number of funds in the sample fluctuates in an alternate way, which rises from 383 by 2001 to 424 by 2002, and falls back to 383 by 2003, then rockets to 638 by 2004 and plummets to 478 by the end of sample. In the third column, we choose S&P/TSX composite index as the benchmark portfolio. If we compare the mean monthly returns of all funds with the monthly returns for the benchmark S&P/TSX composite index, we find that three out of the five mean monthly returns are below the returns from the market benchmark index. In down markets, the mean monthly returns of equity funds surpass those of the benchmark index. That is, for both 2001 and 2002, the mean monthly returns of equity funds are above the monthly returns of the benchmark index, which are negative. In contrast, in the up markets of 2003-2005, the figures of equity funds are lower than that of the benchmark index, which are positive. It is plausible that average managers of equity funds tend to beat down markets but fall short of standing out in up markets.

The effect of survivorship bias upon the mean returns of funds is not trivial. In column 2, we calculate the number and the mean monthly returns each year for funds that survived until the end of 2005. The number of surviving funds gradually rises from 177 by 2001 to 445 by 2004. The figure for 2005 is omitted since by sampling all funds for 2005 must survive until the end of that year. Column 3 reports the number and the mean monthly returns for each year for funds that did not survive until December 2005.

Mortality rate for a given year means the ratio of the number of defunct funds to that of total funds in existence for that year. 2004 is an abnormal year with a huge mortality rate of 30.25%. Considering its surprisingly increased number of funds and the size of market capitalization relatively fixed, we would expect the mortality rate to be higher than for

any other years. Given that survivorship bias has existed, surviving funds are expected to have superior performance to that of all funds in existence. The figures of mean monthly returns of funds give the evidence of survivorship bias in our sample. Except for 2003, all equally-weighted mean monthly returns of the surviving funds are above those of all funds in existence. When it comes to the value-weighted mean monthly returns, all figures of the surviving funds are greater than those of all funds in existence. Moreover, for each year, the mean monthly return of surviving funds is greater than that of nonsurviving funds. Two equally-weighted figures and three value-weighted figures are statistically significant. This finding is consistent with the literature that concludes that excluding the information of nonsurviving funds will bring upward bias to performance analysis.

3. Performance

Modern portfolio theory and asset pricing theory provide the theoretical framework for performance measurement. Given that performance figures are involved with the risk of investment, an appropriate measure of fund performance would be based on at least two dimensions: risk and expected return. In this study, we examine the fund performance using Jensen's Alpha in the context of Capital Asset Pricing Model (CAPM).

The capital asset pricing assumes that a diversified portfolio could insure away some risk, so that only systematic or non-diversifiable market-related risk should be included in a performance measure. Jensen's Alpha uses only systematic risk to evaluate a portfolio's return. This measures the difference of a portfolio's return from its equilibrium level, defined as follows:

$$\alpha_{fd} = (R_{fd} - R_f) - \beta(R_{mkt} - R_f) + \epsilon_{fd}$$

Where α_{fd} is the estimated excess return for fund, R_{fd} is the fund's raw return net of expense, R_f is the risk-free rate, R_{mkt} is the market benchmark return, and ϵ_{fd} is the fund regression residual. β is a measure of a fund's sensitivity to market movements. It can be estimated by regressing the excess raw return net of risk free rate on the excess return of the market. The intercept from running this regression is the Jensen's Alpha. Positive α s imply positive risk-adjusted performance. Thus, a fund with positive α is able to surpass the market benchmark. When funds are rated, the higher the α the better the performance.

In this calculation, we use monthly returns for the fund's raw returns. The risk-free rate is taken to be the 30-day Treasury bill rate as reported by Bank of Canada. Again, we use S&P/TSX composite index as market benchmark.

Table 2. Fund Performance

This table shows average fund alphas estimated by one-factor CAPM model.

Year		All Funds' Alpha		Surviving Funds' Alpha	
		Mean (% per month)	P-value	Mean (% per month)	P-value
2001	EW	0.1863	0.481	0.1911	0.523
	VW	0.3447	0.192	0.4171	0.198
2002	EW	-0.0294	0.851	0.0051	0.977
	VW	0.1208	0.448	0.2148	0.217
2003	EW	-0.2964	0.137	-0.3491	0.141
	VW	-0.3231*	0.098	-0.3375*	0.094
2004	EW	0.1748	0.455	0.2216	0.385
	VW	0.1622	0.452	0.1967	0.375
2005	EW	-0.1209	0.603	----	----
	VW	-0.1200	0.625	----	----
2001-2005	EW	-0.0171	0.192	0.0396	0.386
	VW	-0.0309*	0.098	0.1103	0.108

Note: *denotes statistically significant at 10% significance level.

Table 2 reports information on the performance of funds both for each year and for the entire 55-month sample period.⁸ For each year, we divide the whole sample into two categories, those funds that existed for that year and those funds that survived until the end of 2005. Mean performance is measured both using an equally-weighted average of all fund alphas and a value-weighted average. Specifically, we estimate each fund's

⁸ In this table, the linear model is estimated via OLS. I construct an equally-weighted portfolio of all funds in the sample for each year, then estimate the portfolio's alpha based on twelve average monthly returns of all funds. The intercept estimate is the mean alpha with its corresponding statistical significance level, given by the P-value for the hypothesis that the mean alpha is zero.

monthly alpha one by one based on 12 time series observations, then average out over the whole group using a simple arithmetic way and a net asset value-weighted way.

For all funds that existed in each year, three out of the five equally-weighted mean alphas are negative and two of the five value-weighted mean alphas are negative. But only one figure is statistically significant at the 10% level, given the fact that each estimate is only based on 12 observations. For the whole sample period of 2001-2005, both equally-weighted mean alpha and value-weighted mean alpha are negative (value-weighted mean alpha is statistically significant), which implies that on average Canadian equity funds underperform the market on a risk-adjusted basis. The result corresponds to findings in the literature that general mutual funds may not earn excess return net of expense.

Focusing our attention on the surviving funds, we note that only one out of the four mean alphas is negative. Normally, the mean alpha of surviving funds is greater than that of all funds in existence, which confirms that surviving funds have superior risk-adjusted performance and that the impact of survivorship bias is substantial. The one exception is 2003, in which the negative mean alpha of surviving funds is bigger than that of all funds in existence. In other words, the performance of surviving funds of 2003 does not appear to be superior. This is not surprising, because when we look back to Table 1, raw mean returns for 2003 also exhibit the same evidence. One of the proper explanations would be that from 2002 to 2003, the stock market underwent a major shift from a down market to an up market. The total number of funds that appeared in 2003 distinguishably falls compared to the previous year. We would expect that new funds that appeared in 2003 were able to better perform since they stood out from a down market of 2002, but

they might have failed to maintain their performance until the end of 2005. Therefore, in 2003, the performance of funds that would survive from 2003 through 2005 is slightly worse than that of all funds in existence.

Since expense ratio data are available during the sample period for some funds, we are able to calculate risk-adjusted gross returns of a subsample of funds. The mean MER rises from 2.48% (in 2001) to 2.80% (in 2004 and 2005). Table 3 reports average fund alphas when gross returns are used in the context of the one-factor CAPM model. With all expenses (not including load fees) added back, the average alpha for the funds in the subsample is significantly positive for both equally-weighted and value-weighted figures. Thus, it appears that general Canadian equity funds are likely to beat the market before management expenses deducted, and fund managers do earn gross returns sufficient to cover their expenses. The result offers some confirmation of the argument of Deaves (2004) that managers make positive contribution to fund performance.

Table 3. Fund Performance before Expenses

This table reports average fund alphas when gross returns are used in the context of the one-factor CAPM model.

Year		All Funds' Alpha	
		Mean (% per month)	P-value
2001	EW	0.424559***	0.000
	VW	0.303238**	0.010
2002	EW	0.189569	0.305
	VW	0.301238	0.153
2003	EW	-0.07675	0.643
	VW	-0.13439	0.430
2004	EW	0.439901*	0.091
	VW	0.414095	0.125
2005	EW	0.111938	0.453
	VW	0.094318	0.566
2001-2005	EW	0.19308**	0.032
	VW	0.185185**	0.047

Note: *denotes statistically significant at 10% significance level.

**** denotes statistically significant at 5% significance level.**

***** denotes statistically significant at 1% significance level.**

4. Persistence

Carhart (1997) defines performance persistence as a positive relation between performance ranking in an initial ranking period and the subsequent period. Performance persistence exists if the performance of a fund is consistently above the average performance of a group of similar funds.

4.1 Contingency Table

As mentioned above, academic studies apply a contingency table approach to investigate performance persistence. Following Malkiel (1995), we construct two-way tables to analyze whether successful performance continues over successive years. For each year, we rank funds as winners/losers based on whether the funds' alphas are above or below the median for all funds. The data in Table 4 show strong evidence that the successful funds with larger alphas tend to repeat their good performance in the following year, which is consistent with the findings of Deaves (2004). "Hot hands" phenomena occur much more often in one-year period than in a medium term. Looking at the first column, the figures of percentage repeat winners for the succeeding year are between 52.08% and 62.71%, three of the four years rejecting the null hypothesis of no winning persistence. As for a medium term, the pattern of winning persistence is broken down for 2003, that is, winning following losing and vice versa. Similarly, winning funds ranked in 2001 cannot persist their good performance in 2005, where winners' repeating percentage is significantly negative. Therefore, the result of contingency table analysis provides

Table 4. Tests of Persistence of Fund Performance (1)

This table presents two-way tables of winner/loser funds based on their alphas over subsequent years

Initial Year	Next t+1		Percentage Repeat		Next t+2		Percentage Repeat		Next t+3		Percentage Repeat		Next t+4		Percentage Repeat		
	W	L	Year	Z-Test	W	L	Year	Z-Test	W	L	Year	Z-Test	W	L	Year	Z-Test	
2001	W	47	29	61.84**	2.06	39	37	51.32	0.22	48	28	63.14**	2.29	30	46	39.48*	-1.83
	L	29	48			37	40			28	49			46	31		
2002	W	50	46	52.08	0.41	65	31	67.71***	3.47	52	44	54.17	0.82				
	L	47	50			30	66			46	51						
2003	W	74	44	62.71***	2.76	57	61	48.31	-0.36								
	L	44	74			61	57										
2004	W	130	93	58.56**	2.55												
	L	95	128														

Note: W represents Winners, L represents Losers.

*denotes statistically significant at 10% significance level.

** denotes statistically significant at 5% significance level.

*** denotes statistically significant at 1% significance level.

support for the hypothesis that better performers are likely to persist only over a short-term future but not over a medium-term future.

4.2 Quartile Ranking and Ordered Probit Model

Aside from median rankings, we apply quartile rankings to test persistence of funds over successive periods. The rankings range from 1 to 4 for the time period covered. Quartile rankings are compiled by sorting the funds by their risk-adjusted performance of the previous year. Funds with the highest alphas are ranked in the top 25%, whereas funds with the worst alphas are ranked in the bottom 25%. When it comes to testing performance persistence in the context of quartile ranking, the contingency table method is inadequate for the following three reasons. First, it can only provide evidence of the existence or non-existence of performance persistence rather than estimates of the magnitude of the performance persistence. Second, it cannot control for the factors that may affect the conclusion of the performance persistence compared to a regression-based method. Third, this nonparametric method can only test whether a fund's performance is persistently higher or lower than the average (median). It cannot be applied to situations when the returns are coded into more than two categories. The variable of interest here is the quartile ranking. It is discrete, measured only on an ordinal scale. Thus, an ordered probit model is introduced.

4.2.1 Methodology

In the ordered probit model, the dependent variable y denotes outcomes representing ranked categories. In this study, mutual funds can be categorized according to quartile rankings. All funds are ranked by their alphas. Funds ranked in the top 25%

are assigned quartile one, the next 25% are assigned quartile two, those ranked from 51% to 75% are assigned quartile three and the bottom 25% are assigned quartile four. As specified by the ordered probit model, the dependent variable can be modeled by considering a latent variable y_i^* that depends linearly on the explanatory variables x_i :

$$y_i^* = x_i' \beta + \varepsilon_i \quad (1)$$

The observed y_i is determined from y_i^* using the rule:

$$y_i = \begin{cases} 1 & \text{if } \mu_3 < y_i^* \\ 2 & \text{if } \mu_2 < y_i^* \leq \mu_3 \\ 3 & \text{if } \mu_1 < y_i^* \leq \mu_2 \\ 4 & \text{if } y_i^* \leq \mu_1 \end{cases} \quad (2)$$

In this paper, y_i is the quartile ranking of the study period, y_i^* is the unobservable index of “creditworthiness”, x_i is the quartile ranking of the prior period, μ_3 , μ_2 , and μ_1 are the threshold values of the boundary at the 25th, 50th, and 75th percentiles, respectively.

It follows that the probabilities of observing each value of y_i are given by:

$$\begin{aligned} \Pr[y_i = 1 | x_i] &= \Pr[\mu_3 < x_i' \beta + \varepsilon_i] = \Pr[\mu_3 - x_i' \beta \leq \varepsilon_i] = 1 - F[\mu_3 - x_i' \beta] \\ \Pr[y_i = 2 | x_i] &= \Pr[\mu_2 < x_i' \beta + \varepsilon_i \leq \mu_3] = \Pr[(\mu_1 - x_i' \beta) < \varepsilon_i \leq (\mu_2 - x_i' \beta)] \\ &= F[\mu_3 - x_i' \beta] - F[\mu_2 - x_i' \beta] \\ \Pr[y_i = 3 | x_i] &= \Pr[\mu_1 < x_i' \beta + \varepsilon_i \leq \mu_2] = \Pr[(\mu_1 - x_i' \beta) < \varepsilon_i \leq (\mu_2 - x_i' \beta)] \\ &= F[\mu_2 - x_i' \beta] - F[\mu_1 - x_i' \beta] \\ \Pr[y_i = 4 | x_i] &= \Pr[x_i' \beta + \varepsilon_i \leq \mu_1] = \Pr[\varepsilon_i \leq \mu_1 - x_i' \beta] = F[\mu_1 - x_i' \beta] \end{aligned} \quad (3)$$

Where $F [.]$ is the cumulative distribution function of ε_i . The ordered probit model assumes that ε_i is distributed normally with mean zero and variance one. So $F [.]$ is the standard normal cumulative distribution function of ε_i .

The threshold values μ_i are estimated along with the β coefficients by maximizing the log likelihood function:

$$\log L(\beta, \mu) = \sum_{i=1}^n \sum_{j=1}^4 \log(\Pr[y_i = j|x_i, \beta, \mu]) \cdot I(y_i = j) \quad (4)$$

Where $I(.)$ is an indicator function, which takes the value 1 if the argument is true, and 0 if the argument is false.

An estimate β in the probit model does not estimate the change in the probability of $y_i=1,2,3$ or 4 due to a unit change in the explanatory variable. This probability change is given by the partial derivative of the expression for $\Pr[y_i = 1,2,3 \text{ or } 4|x_i]$ with respect to the independent variables. It is called estimated marginal effect of x_i on the response probability, which can be calculated by:

$$\begin{aligned} \frac{\partial \Pr[y_i = 1|x_i]}{\partial x_k} &= -\beta_k F(\mu_3 - x_i' \beta) \\ \frac{\partial \Pr[y_i = 2|x_i]}{\partial x_k} &= \beta_k [F(\mu_2 - x_i' \beta) - F(\mu_3 - x_i' \beta)] \\ \frac{\partial \Pr[y_i = 3|x_i]}{\partial x_k} &= \beta_k [F(\mu_1 - x_i' \beta) - F(\mu_2 - x_i' \beta)] \\ \frac{\partial \Pr[y_i = 4|x_i]}{\partial x_k} &= \beta_k F(\mu_1 - x_i' \beta) \end{aligned} \quad (5)$$

Note that if a change in an x_i value increases y_i^* , the probability of having $y_i = 1$ definitely increases, the probability of having $y_i = 4$ definitely decreases, but the probabilities of having $y_i = 2$ or $y_i = 3$ can move in either direction.

4.2.2. Empirical Results

Table 5 reports the probability of quartile rankings repeating over two subsequent years and marginal effects of past rankings on probability of current rankings. For all years under study, three of the four cases exhibit similar patterns. That is, funds being ranked in the top 25% in the past year have a significant probability of being ranked in the top 25% again in the present year, the figure ranging from 31.5% to 35.1%. Symmetrically, for those cases, funds being ranked in the bottom 25% in the last year have a significant probability of being ranked in the bottom 25% in the present year, the figure ranging from 31.3% to 35.9%. Thus, both best winners and worst losers tend to persist with their performance over a short term. Moreover, a fund ranked in the top/bottom 25% in the prior year has a lower probability of being ranked in the bottom/top 25% the present year. The figure is ranged from 15.4% to 19.0% for all significant cases. That is to say, funds that had the best/worst performance in the last year are less likely to have inferior/superior performance this year. This evidence is broadly consistent with the literature. However, the evidence of performance persistence is not significant for the year of 2003, in which we compute the probability of quartile rankings repeating based on 2002 rankings. The probabilities are indistinguishable and all of them are around 25%. Thus, for this particular year, the chance of winning/losing followed by winning/losing is somewhat the same as the chance of winning/losing followed by losing/winning. Note that in the period of 2002-2003, the stock markets experienced huge fluctuations, with the market switching from a down market to an up market. Thus, we would expect that persistence was broken down by this major shift. The results here may imply that the less the persistence the more volatile the market.

Table 5. Tests of Persistence of Fund Performance (2)

This table presents marginal effects of past rankings on probability of current rankings, where the rankings are sorted by funds' alpha.

Year	Ranking	Top quartile in year t-1			Bottom quartile in year t-1		
		Probability	Marginal effect	P-Value	Probability	Marginal effect	P-Value
2002	Top	0.3507***	-0.07853***	0.000	0.1541***	-0.05029***	0.000
	Bottom	0.1593***	0.05141***	0.000	0.3588***	0.07917***	0.000
2003	Top	0.2474	0.00120	0.945	0.2509	0.00120	0.946
	Bottom	0.2543	-0.00121	0.945	0.2507	-0.00120	0.946
2004	Top	0.3152***	-0.04682**	0.025	0.1904***	-0.03580***	0.003
	Bottom	0.1885***	0.03558***	0.003	0.3127***	0.04666**	0.026
2005	Top	0.3323***	-0.06109***	0.001	0.1741***	-0.04322***	0.000
	Bottom	0.1749***	0.04335***	0.000	0.3335***	0.06118***	0.001

Note: P-value indicates the statistic significance for marginal effect on the response probability.

**** denotes statistically significant at 5% significance level.**

***** denotes statistically significant at 1% significance level.**

The sign and magnitude of estimated marginal effect provide more implications to persistence analysis. If we take 2002 for instance, the marginal effect of quartile 1 ranking in 2001 on the probability of quartile 1 ranking in 2002 is -0.07853, which means that the probability of being ranked as quartile 1 is about 7.853% lower when ranking in 2001 falls from quartile 1 to quartile 2. It seems surprisingly contradictory that the marginal effect of quartile 4 ranking in 2001 on probability of quartile 1 ranking in 2002 is negative. One would expect the sign of marginal effect should be opposite to that of quartile 1 ranking in 2001. However, the sign is correct. This is because when quartile ranking rises from quartile 4 to quartile 3, numerically the independent variable x_i falls. The marginal effect now is negative, which means the change in probability would rise

with respect to a fall in the independent variable x_i . Therefore, when ranking in 2001 rises from quartile 4 to quartile 3, the probability of being ranked as quartile 1 in 2002 is about 5.029% higher. Symmetrically, the marginal effect of quartile 4 ranking in 2001 gives support to the proposition that a fall in quartile ranking from 1 to 2 in 2001 would increase the probability of being ranked in quartile 4 in 2002, and that a rise in quartile ranking from 4 to 3 in 2001 would reduce the probability of being ranked in quartile 4 in 2002. For all significant cases, the signs of marginal effect are consistent and the magnitudes shed light on the extent of the performance persistence. Note that the marginal effect is small for 2003 when the existence of performance persistence is not statistically significant and this magnitude becomes noticeable when the existence of performance persistence becomes significant. The analysis of marginal effect shows that funds being ranked in the top 25% for a given year have a probability of being ranked at top 25% again the following year, whereas the funds being ranked in the second top 25% for a given year have a low chance of being in the top 25% the following year.

Elton, Gruber and Blake (1996) found that raw returns give greater persistence prediction than risk-adjusted returns. To explore this phenomenon, we retest persistence by the ordered probit model on fund raw returns with reports shown by Table 6. The results are distinguishable from those estimated using fund risk-adjusted returns and confirm their findings. Except for 2003, the probabilities that funds can be ranked in the top quartile successively are larger and highly significant, ranging from 38.6% to 44.4%. Symmetrically, for those years, the probabilities that funds can be ranked in the bottom quartile successively are also larger and highly significant, ranging from 38.3% to 43.9%. Compared with probability figures estimated on risk-adjusted returns, the probability of

Table 6. Tests of Persistence of Fund Performance (3)

This table presents marginal effects of past rankings on probability of current rankings, where the rankings are sorted by funds' raw returns.

Year	Ranking	Top quartile in year t-1			Bottom quartile in year t-1		
		Probability	Marginal effect	P-Value	Probability	Marginal effect	P-Value
2002	Top	0.4443	-0.15722	0.000	0.0911	-0.06521	0.000
	Bottom	0.0891	0.06414	0.000	0.4394	0.15694	0.000
2003	Top	0.1742	0.04208	0.000	0.3276	0.05913	0.008
	Bottom	0.3331	-0.0595	0.008	0.1781	-0.04268	0.000
2004	Top	0.3863	-0.1047	0.000	0.1334	-0.05896	0.000
	Bottom	0.1320	0.05851	0.000	0.3836	0.10453	0.000
2005	Top	0.4373	-0.1528	0.000	0.0932	-0.06463	0.000
	Bottom	0.0942	0.06516	0.000	0.4397	0.15297	0.000

Note: P-value indicates the statistic significance for marginal effect on the response probability. All figures are statistically significant at 1% significance level.

winners/losers continuing their rankings rises by average 8%. Also, a fund ranked in the top/bottom 25% in the prior year has an even lower probability of being ranked in the bottom/top 25% this year. The figures are ranged from 8.9% to 13.3%, around 6% less than those estimated on risk-adjusted returns. That is to say, performance reversal over the subsequent year is less likely occurred when we look at raw returns without considering investment risks. However, for the particular year of 2003, fund performance reverses, that is, funds in the top 25% in 2002 have a 33.3% probability of falling to the bottom 25% in 2003 and funds ranked in the bottom 25% in 2002 have a 32.8% probability of rising to top 25% in 2003. It is reasonable that when the market undergoes a major shift from a down market to an up market, the worst performers have to improve

in order to survive, thus a reversal of fund performance occurs. If we ignore the risk, the reversal effect becomes substantial and breaks down fund persistence. Although the raw returns analysis is straightforward and accessible to retail investors, it does not take fund risk or fund volatility into consideration, which is gauged by risk-adjusted returns analysis. Funds with high volatility have a tendency of being in the top rankings if they survive. Thus, their high volatility will also tend to put them toward the top rankings with more frequency in the subsequent period, resulting in overestimated persistence. Consequently, it is natural that raw returns show more prominent persistence than risk-adjusted returns.

5. Simulative Strategies

It can be argued that risk-adjusted studies involving complicated computer analyses are only accessible to researchers and academics. They do not reflect the information obtainable to retail investors. As the literature suggests that some persistence in mutual fund returns exists, we try to simulate a practicable investment strategy based on raw returns to test whether such persistence is economically significant.

The strategy involves a procedure whereby the investors buy an equally-weighted portfolio of equity funds based on their performance over the preceding 12 months, hold the portfolio for a medium term and expect the average annual returns of the top quartile portfolio over the holding period to outstand the other three quartile portfolios. We construct the portfolios according to funds' annual return ranking and then obtain the average annual returns of each portfolio over subsequent years. The results are summarized in Table 7. Column 1 indicates that the portfolio ranked at the very top for all years had higher average annual returns during the following year than did the portfolio ranked at the very bottom. However, the average annual returns of intermediate portfolios for 2003 based on 2002 performance do not correspond to their rankings. Concretely, the average annual return of the second-highest-ranking portfolio is lower than the average annual return of the third-highest-ranking portfolio in 2003. This is not surprising because we find this abnormal phenomenon of 2003 in the earlier sections.

Results in column 2 show a weaker evidence of persistence for the top-ranking portfolio and bottom-ranking portfolio in the following two years. The gaps in average

Table 7. Strategy of Holding Portfolios

This table shows the average annual returns for the strategy of holding a portfolio over subsequent periods based on initial year performance.

Quartile Ranking in t	Portfolio returns in $t+1$ period (%)	Average over $t+1, t+2$ periods (%)	Average over $t+1, t+2, t+3$ periods (%)	Average over $t+1, t+2, t+3, t+4$ periods (%)
2001				
1 st	-8.323684	5.024868	7.071053	8.970395
2 nd	-8.894737	3.876184	6.217807	7.971908
3 rd	-13.41842	2.690921	4.890439	7.305987
4 th	-16.02564	1.661538	4.38547	7.299359
2002				
1 st	19.52667	14.82906	14.65694	--
2 nd	18.77187	15.04448	15.44701	--
3 rd	18.09646	14.07552	14.5059	--
4 th	16.39833	13.74187	13.97236	--
2003				
1 st	13.41864	15.59322	--	--
2 nd	9.754576	12.07475	--	--
3 rd	11.08864	13.58559	--	--
4 th	9.130508	11.18568	--	--
2004				
1 st	18.3625	--	--	--
2 nd	17.13106	--	--	--
3 rd	14.5524	--	--	--
4 th	11.80381	--	--	--

returns in the subsequent two years between the top portfolio and bottom portfolio tend to be indistinguishable compared with the gaps in the subsequent year. Once again, in two out of three cases, portfolios ranked in the intermediate categories have opposite average annual returns with respect to their rankings in the subsequent two years.

Holding strategy implies that Canadian equity funds during 2001-2005 may have short-term performance persistence. Investors who buy shares in the top funds of the past year would be able to gain superior returns in the current year. However, this persistence cannot extend to a medium term. Thus, for a retail investor, chasing top funds year by year is a reliable investment strategy if the existence of load fees and sales fees is ignored.

For concreteness, we devise a chasing strategy and compare it with a holding strategy. The chasing strategy is as follows: At the beginning of every year, a portfolio of top-ranking funds is constructed on the basis of their raw annual returns over the prior year. The investment starts at the beginning of 2002 when the investor buys a portfolio of top quartile funds for 2001. In 2003, the investor reconstructs this portfolio by replacing those funds by the top quartile funds of 2002 and so forth in subsequent years. Table 8 compares the average annual returns of the chasing strategy with those of the holding strategy. The figures for 2001 are the average annual returns of both strategies being invested during the four-year period from 2002 to 2005. The rows for 2002 are the comparison of average annual returns of both strategies being invested during the three-year period from 2003 to 2005 and so forth. It is clear that the average annual returns of chasing strategy are at least equal to or higher than those of holding strategy for each year. If load fees and sales fees are not ignored, to determine whether chasing strategy is more profitable than holding strategy, the investor should take transaction costs into

consideration. If the sum of load fees and sales fees is less than the difference of the average annual returns between the chasing and holding strategies, then chasing top funds is an implementary strategy for retail investors.

Table 8. Holding Strategy vs. Chasing Strategy

This table compares the average annual returns of chasing strategy with those of holding strategy over subsequent periods.

1 st Quartile Ranking in t	Strategy	Portfolio returns in $t+1$ period (%)	Average over $t+1, t+2$ periods (%)	Average over $t+1, t+2, t+3$ periods (%)	Average over $t+1, t+2, t+3, t+4$ periods (%)
2001	Holding	-8.32368	5.024868	7.071053	8.970395
	Chasing	-8.32368	5.601493	8.207209	10.746032
2002	Holding	19.52667	14.82906	14.65694	--
	Chasing	19.52667	16.47266	17.1026	--
2003	Holding	13.41864	15.59322	--	--
	Chasing	13.41864	15.89057	--	--
2004	Holding	18.3625	--	--	--
	Chasing	18.3625	--	--	--

6. Conclusion

This paper has examined Canadian equity funds returns from June 2001 to December 2005 and utilized a data set that includes the returns from all mutual funds in existence at any point in time of that period. Our dataset has enabled us to measure the extent of survivorship bias, which arises due to the discarding of information about the defunct funds from current fund records. As what has been addressed in the literature using US data, our analysis has shown that the effect of survivorship bias is substantial in the sample. When fund performance has been analyzed in the context of the one-factor CAPM model, we have found that Canadian equity funds underperform the market benchmark on average over the study period, but in general Canadian equity funds are likely to beat the market before management expenses deducted, a conclusion similar to the earlier studies in the US.

Consistent with the finding of Deaves (2004), we have found that Canadian equity funds exhibit at least a short-term performance persistence. An ordered probit model has been introduced to investigate the funds' performance based on their quartile rankings. It has estimated the magnitude of short-term performance persistence of funds for top quartile and bottom quartile rankings. Moreover, there is evidence that a fund being ranked at the very top for a given year has a probability of being ranked at the very top again the following year, whereas the chance of super success the following year for a fund ranked second the current year is relatively low. Also, we have found that the

persistence tends to break down when there is a shift from a down market to an up market. Finally, based on strong evidence of one-year performance persistence, we have reached the conclusion that chasing top funds year by year is a reliable investment strategy if the existence of load fees and sales fees is ignored.

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