

Parametric Portfolio Associates

Research Report

Measuring and evaluating portfolio performance after taxes

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Measuring and evaluating portfolio performance after taxes

Abstract

We address the question of how an investor should evaluate the *after-tax* performance of a portfolio of US equities. While portfolio performance evaluation has been well studied and has received standard answers on a *pre-tax* basis, it is far more complex when taxes are considered. We focus on two topics. First, we discuss the valuation of a portfolio with an imbedded tax liability and propose a simple method for estimating value. Second, we discuss issues surrounding benchmark definition and document the after-tax returns of an S&P500® benchmark from various starting dates.

Introduction

For most investors, taxes represent a very large performance drag – often larger than transaction costs, management fees, or inflation. It is important for investors to consider the effect of taxes on all their investment decisions including asset allocation (Jacob [1995]) and manager selection (Arnott [1993]). The popular sentiment is that investors should not allow their investment decisions to be dominated by tax considerations; however, the trade-off between seeking expected return and the tax consequence of doing so is usually given too little attention.

Since the impact of taxes is sizable and the tax burden varies with investment manager (Dickson and Shoven [1993]), it is essential that investors evaluate their portfolio performance on an after-tax basis. In this paper we address the question of how an investor should evaluate the *after-tax* performance of a portfolio of equities.

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There are well-established methods for evaluating portfolio performance on a pre-tax basis, see e.g., Grinold and Kahn [1995]. The investor observes the stream of investment returns over time and evaluates the performance of the portfolio manager via a set of summary measures, often making comparisons with a benchmark. A major focus is on adjustments for risk, in terms either of total standard deviation or tracking error. The analysis is easy and provides a useful overview of the manager's performance.

There is little published literature on after-tax performance evaluation. In addressing this topic, we immediately confront two issues.

First, while it is straightforward to determine the market value of a portfolio of marketable securities, the same notion of "value" is less obvious for a portfolio with a tax liability. The few who have addressed this subject have usually made simplifying assumptions. AIMR guidelines for investment managers [1997] (the flow method) require only that returns be computed based on the change in market value, and do not require an evaluation of the tax liability. Poterba [1997] discusses the "contingent future tax liability" and views it as an uncertain random variable. Constantinides [1984] discusses the tax liability as an option, which the investor can pay now or later. Few money managers or mutual funds report after-tax return.

Second, the definition of the benchmark is substantially more complex in the presence of taxes. No standard after-tax benchmarks are published. Most authors make very simple assumptions on the investment period in order to determine after-tax market performance. Siegel and Montgomery [1995] assume that investors close out their positions after five years. Jeffrey and Arnott [1993] consider the fixed 1982-1991 investment period with final liquidation.

In this paper we address portfolio valuation by proposing a "full cost equivalent" value. This is essentially the present value of the portfolio under assumptions on horizon, investment return, tax rates and turnover. Our measure can be interpreted as a liquidation value at a tax rate that is lower than the investor's true rate. We address the benchmark

issue by documenting after-tax returns of a carefully simulated S&P500 portfolio, and by discussing how to approximate after-tax benchmarks.

Our analysis pertains to a separate US equity account rather than a commingled account such as a mutual fund. Commingling leads to additional complexities, though many of the performance evaluation questions can be addressed similarly. In a commingled account, investment actions of other investors often result in additional tax consequences, both positively and negatively.

After-tax Portfolio Valuation

Performance evaluation must start with a determination of portfolio value. At each point in time, we assume that the market value of the portfolio is known. However, the investor has not yet paid taxes on unrealized capital gains. We take the position that these taxes are properly viewed as a liability of the portfolio and must be considered in an accurate calculation of portfolio value.

True after-tax performance evaluation requires that any taxes incurred are charged to the portfolio account. Unfortunately in practice, the payment of taxes is often de-coupled from the portfolio: taxes are charged to a separate account and at a later date. This removes the focus from true after-tax performance.

There are two important components to portfolio value: the current market value, V_m , and the cost basis, V_c . As an example, consider the valuation of portfolio P1, with market value \$100 and cost basis \$50, and portfolio P2, with market value of \$95 and cost basis \$90. Which portfolio is more valuable, and why?

Consider first two simple estimates of portfolio value.

Market value, V_m

Omitting the tax liability, we obtain as value V_m , the current market value of the portfolio. This value overstates true value. At such time a security is sold for a gain and taxes withdrawn, V_m will be reduced.

Liquidation value, V_1

At the other extreme, consider what happens if we were to liquidate the portfolio immediately at the tax rate¹ t_g . The liquidation value is:

$$V_1 = V_m - t_g(V_m - V_c).$$

In the case of an investor with no desire to liquidate, the liquidation value understates true value.

Both of these methods fall short because they over-simplify the tax liability. If we assume that the portfolio will remain invested into the future, the true tax liability depends on:

- the investment horizon
- the final disposition of the assets (some investors receive a step-up in tax basis on a bequest to heirs)
- future tax rates
- future returns – both capital appreciation and dividends (through investment returns on unrealized taxes)
- the rate at which capital gains will be realized over the period (this is related to portfolio turnover)

An alternative valuation: *Full Cost Equivalent Value of a portfolio*

The investor desires a fair accounting valuation of a portfolio with market value V_m and cost basis V_c . Let us assume an investment horizon of N periods at which point the portfolio will be liquidated and any unrealized taxes will be paid². Under assumptions on return (r), dividend rate (d), dividend tax rate (t_d), capital gains tax rate, (t_g), and the rate at which gains are realized (g), we can compute the final after-tax value of the portfolio. Let V_1 and C_1 be the market value and cost basis respectively of the portfolio at the start

of period I. Then taxes are due on dividends dV_1 at the end of the period, and the capital gain realized is $g[(1+r-d)V_1 - C_1]$. Dividends and capital gains are re-invested, and taxes paid from the portfolio. For simplicity³ we allow capital losses, and credit the portfolio with the value of the tax saving. Then, at the start of period I+1,

$$C_{I+1} = C_1 + (1-t_d)dV_1 + g(1-t_g)[(1+r-d)V_1 - C_1]$$

(1)

$$V_{I+1} = (1+r)V_1 - t_d dV_1 - t_g g[(1+r-d)V_1 - C_1]$$

(2)

The final liquidation value after N periods is $V_N - t_g(V_N - C_N)$

The difference equations (1) and (2) provide the cost basis and market value of the portfolio at each stage in time.

Now, to determine the value of the portfolio we ask: what current cash value will result in terminal wealth equal to that of the portfolio, under the same investment assumptions? We term this the Full Cost Equivalent (FCE) value of the portfolio. If $V_c < V_m$, the FCE value lies between the market value and liquidation value.

Returning to the previous example, let us make some simple parametric assumptions. We assume a 20-year horizon at which point assets will be liquidated, that the market will return a total 10% per year including a dividend rate of 3%; that the tax rate is 28% on capital gains and 40% on dividends; and that 5% of the capital gain is realized each year⁴. Under these assumptions, portfolio P1 with market value \$100 and cost basis \$50, will evolve over 20 years to a liquidation value of \$398.80. See table 1A for details. Similarly, an initial cash investment of \$100 will evolve over the same period and the same return assumptions to \$425.31, see table 1B. An investor is therefore indifferent between P1 and a cash value of $\$100 \times 398.80 / 425.31 = \93.8 now. This \$93.8 is the FCE value. Applying this procedure to portfolio P2 with market value \$95 and cost basis \$90, we obtain its FCE value of \$94.4. Portfolio P2 is then slightly preferable, but this

conclusion is sensitive to the numerical values specified. That is, changes to the return expectation, the tax rates and the realization rate will change this evaluation.

Figure 1 shows the relationship between FCE and cost basis under these same numerical assumptions.

Note that in Figure 1 the FCE value, V_f , is linear with cost basis. Mathematically, equations (1) and (2) allow us to write:

$$V_f = V_m - f t_g (V_m - V_c) \quad (3)$$

for some value of f , $0 \leq f \leq 1$. Comparing with the definition of liquidation value V_l , we can think of the FCE value as a liquidation value, but with the modified tax rate $f t_g$: The factor f adjusts the actual tax rate downwards. The investor prefers a low value of f to a high value. When the horizon is 0 (i.e. immediate liquidation), $f=1$. The multiplier f is not dependent on the cost basis, but is determined by the investment parameters assumed above. For the numeric example given, $f=0.44$ ⁵. To obtain the current market value, V_m , set $f=0$ regardless of cost basis.

A simple method for portfolio valuation, then, is to use expression (3), with a suitable multiplier, f . The value of the multiplier depends on the *investor*, his horizon, tax rates, return expectations and gain realization rate.

An important parameter is the rate at which capital gains are realized. In this example, if we change the expected tax realization rate from 5% (typical of a passive indexed portfolio) to 70% (more typical of an active manager), the value of the portfolio changes substantially. At 70% realization rate, portfolio P1 has FCE value of \$87.2 and portfolio P2 has FCE value \$93.7. Thus, if the investor changes his expectation of manager turnover, then the value of the portfolio changes. This reflects the tax cost of high turnover, particularly for portfolios with high unrealized gains. Arnott [1993] similarly discusses the deferral of taxes under low turnover and how the unrealized taxes compound in the investor's favor.

How does the multiplier f vary with its parameters? Figures 2, 3 and 4 show how f depends on gain realization, horizon and investment return, when all other parameters are held constant. We see that f depends critically on the rate at which capital gains are realized, and drops fast if turnover is kept low. Horizon matters if it is less than about 10 years, but beyond this point it does not affect valuation much. Higher return assumptions reduce f because the unrealized gains can be re-invested at a higher rate.

We have found the FCE value, V_f , to be a useful concept both for portfolio valuation and for security valuation prior to trading.

After-tax Benchmarking

In evaluating portfolio performance, the benchmark is key. We want to compare after-tax returns with those of an after-tax benchmark.

An easy alternative to investing in the portfolio is to invest in a diversified index such as the S&P500. An ideal benchmark, then, is an indexed portfolio with the same cash flows as that of the investor. Investment flows affect both portfolio performance and benchmark performance since taxes due depend on the cost basis at which the securities were acquired.

A simple way to estimate after-tax return is to reduce the return sequence of an S&P500 indexed mutual fund for taxes on dividends and capital gains. However, this is problematical. Most such funds incur fees and tracking deviations from the index. In general, taxes incurred by a portfolio are affected both by the actions of the investors (deposits and withdrawals) and by the actions of the portfolio manager (turnover). The recent large investment flows to many indexed mutual funds have allowed the funds to be re-balanced with minimal gain realization, and these funds have built up large unrealized gains⁶. Importantly, the capital gain distributed by a mutual fund is not the same as the gain incurred by an investor with his particular sequence of investment flows.

We determine the after-tax return of an S&P500 indexed portfolio by a careful stock-by-stock computer simulation using historical price returns, dividends and S&P500 constituent weights. Taxes are withdrawn and dividends re-invested each month. While our simulation software enables us to determine index returns for an arbitrary sequence of cash flows, we assume here a single initial investment that is left to appreciate over time; sales are required because of changes to the index and because of corporate actions by constituent firms. The tables show simulations from different starting dates since 1985, each of which establishes a different cost basis; this allows us to observe the effect of the starting date on after-tax return. The simulation methodology is detailed in a footnote⁷.

Table 2A shows the annual pre-tax return and after-tax market value return (percentage change in V_m) for a portfolio initiated on the first day of each year. Table 2B shows the FCE return (percentage change in FCE value V_f) for the same set of portfolios. The FCE assumptions are as before.

A number of observations can be made. First, note the substantial difference, by both return measures, between pre-tax and after-tax return. This has implications for asset allocation studies. Second, FCE returns are routinely, and substantially, below market value returns over the period. As one approaches a liquidation horizon, this will change, and the market value return will drop when taxes are finally realized. Third, comparing returns across different starting dates for the market value returns in Table 2A, we find that returns tend to be lower if the holding period has been longer: in the strong bull market over the period, sales of securities with lower cost basis incur larger tax consequences. Even though the portfolio turnover is low (approximately 5% on average for the S&P500), the variation of return with starting date can be well in excess of 1%. A “vintage 1985” portfolio has a 20.96% return in 1996, while a “vintage 1996” portfolio has a 21.74% return. This difference grows with the age difference of the portfolios or when the market returns are high. Similar comments hold for the FCE returns in Table 2B.

While tables 2A and 2B show the returns of an S&P500 benchmark from specified starting points, applying these to evaluate the performance of a portfolio with alternative cash flows is more complex. The ideal solution is to simulate a benchmark with the same investment flows as the portfolio. Such a stock-by-stock simulation is not trivial. The tables in this paper are useful if one can assume that cash flows occur at the start of each year. Alternatively, simplifications can yield close approximations. For example, by treating an investment in the S&P500 as a single security and using the actual S&P500 turnover level each month, one can apply the difference equations of (1) and (2) to estimate how the cost basis and value of the benchmark change over time. Or, one can compute the weighted average life of the portfolio and use the tables to approximate the return of the benchmark.

Comments

We have discussed issues of after-tax portfolio performance evaluation. This subject is complicated first by the valuation of the unrealized tax liability and second by the difficulty of establishing a benchmark. For benchmarking, we have documented after-tax returns of the S&P500 between 1985 and 1996.

After-tax performance depends on the investor's sequence of investment flows. After-tax returns are path-dependent in that they depend on how the assets grow over time and when the cost basis is established. Two portfolios that have precisely the same current holdings have different after-tax returns if they were initiated at different points in time and their cost bases differ. The notion of a precise after-tax benchmark return each period that is applicable to all portfolios does not exist in the same way as it does on a pre-tax basis. A one-size benchmark does not fit all, even if all have the same tax rate.

While we have begun to address questions on after-tax portfolio evaluation, others remain. For example, the subject of *risk* changes in the presence of taxes. A loss may have a different value than a gain because of its tax treatment. Another practical question:

given an undiversified low-basis portfolio, what is it worth paying in taxes right now in order to diversify?

It is an oversimplification to avoid the subject and focus only on pre-tax return.

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Table 1A

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>.....</i>	<i>Year 20</i>
Starting market value	100	108	116.64		430.97
Starting cost basis	50	53.85	58.02		210.79
Ending market value, before taxes, divs	107	115.56	124.81		461.14
Dividends	3	3.24	3.5		12.93
Gain (unrealized)	57	61.71	66.79		250.35
Realized gain	2.85	3.09	3.34		12.52
Taxes paid	2	2.16	2.33		8.68
Re-investment	3.85	4.17	4.50		16.77
Ending cost basis	53.85	58.02	62.52		227.56
Ending value	108	116.64	125.97		465.39
Liquidation value					398.80

Table 1A shows how a portfolio with initial market value of \$100 and cost basis \$50 will evolve over 20 years. We assume an annual price appreciation of 7%, a dividend rate of 3%, and an annual capital gain realization rate of 5%. The tax rate on dividends is 40% and capital gains is 28%.

Table 1B

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>.....</i>	<i>Year 20</i>
Starting market value	100	108.7	118.07		453.05
Starting cost basis	100	102.05	104.52		243.32
Ending market value, before taxes, divs	107	116.31	126.33		484.76
Dividends	3	3.26	3.54		13.59
Gain (unrealized)	7	14.26	21.81		241.44
Realized gain	0.35	0.71	1.09		12.07
Taxes paid	1.3	1.5	1.72		8.82
Re-investment	2.05	2.47	2.91		16.85
Ending cost basis	102.05	104.52	107.43		260.17
Ending value	108.7	118.07	128.15		489.53
Liquidation value					425.31

Table 1B shows how a portfolio with initial market value of \$100 and cost basis \$100 will evolve over 20 years. We assume an annual price appreciation of 7%, a dividend rate of 3%, and an annual capital gain realization rate of 5%. The tax rate on dividends is 40% and capital gains is 28%.

Table 2A

After tax Market Value Return

	<i>Pre-tax Return</i>	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1985	32.16	28.79											
1986	18.47	16.01	16.31										
1987	5.23	3.19	3.30	3.71									
1988	16.81	14.07	14.20	14.69	15.07								
1989	31.49	28.58	28.68	29.04	29.46	29.83							
1990	-3.17	-5.01	-4.97	-4.59	-4.25	-4.23	-4.10						
1991	30.55	28.20	28.25	28.73	29.19	29.21	29.31	29.12					
1992	7.67	5.87	5.90	6.24	6.57	6.59	6.67	6.52	6.66				
1993	9.99	8.12	8.19	8.44	8.78	8.84	8.96	8.79	8.94	8.71			
1994	1.32	-0.56	-0.50	-0.26	0.05	0.12	0.29	0.15	0.39	0.11	0.15		
1995	37.59	35.01	35.10	35.27	35.69	35.70	35.89	35.64	35.89	35.64	35.74	35.72	
1996	22.96	20.96	21.01	21.12	21.43	21.47	21.56	21.38	21.50	21.29	21.37	21.39	21.74
Final Value		511.86	401.01	354.89	352.19	307.59	238.79	246.72	192.63	179.05	164.99	164.76	121.74
Final cost basis		194.66	164.46	154.75	155.52	142.89	127.25	126.82	116.02	111.69	108.37	106.53	101.80
Avg. Ann. Return		14.58	13.46	13.50	15.01	15.08	13.24	16.24	14.01	15.68	18.16	28.36	21.74

Each column shows the annual after-tax market value return sequence of an S&P500 indexed portfolio, invested on 1st Jan. of that year. Final value and final cost basis represent the final portfolio values at 12/31/96 on \$100 invested at the beginning.

Table 2B

After tax Full Cost Equivalent (FCE) Return

	<i>Pre-tax Return</i>	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1985	32.16	25.66											
1986	18.47	14.84	14.59										
1987	5.23	3.39	3.36	3.63									
1988	16.81	13.23	13.04	13.29	13.69								
1989	31.49	26.60	26.23	26.23	26.64	26.54							
1990	-3.17	-4.33	-4.26	-3.84	-3.47	-3.44	-3.28						
1991	30.55	26.20	25.91	26.14	26.57	26.35	25.73	25.79					
1992	7.67	5.77	5.73	6.02	6.36	6.33	6.25	6.16	6.09				
1993	9.99	7.97	7.93	8.11	8.45	8.43	8.34	8.25	8.14	7.86			
1994	1.32	-0.09	-0.07	0.15	0.48	0.51	0.60	0.49	0.61	0.34	0.36		
1995	37.59	33.14	32.93	32.89	33.25	33.09	32.67	32.65	32.13	31.70	31.51	31.57	
1996	22.96	20.22	20.14	20.15	20.45	20.39	20.21	20.14	19.92	19.62	19.56	19.60	19.21

Avg. Ann. Return

Each column shows the annual after-tax Full Cost Equivalent (FCE) return sequence of an S&P500 indexed portfolio, invested on 1st Jan. of that year.

Footnotes

¹ For simplicity here, t_g is the tax rate on both long and short term capital gains.

² A similar analysis can be obtained under an assumption of basis step-up at the horizon.

³ The assumption holds in the case of high net-worth investors with substantial capital gains in their aggregate investments

⁴ The 5% realization rate on capital gains is typical of an indexed S&P500 portfolio. Active portfolios that realize taxes in order to seek active returns typically incur realization rates substantially in excess of this amount.

⁵ Using (3), with $V_f = 93.8$, $V_m = 100$, $V_c = 50$, and $t_g = .28$.

⁶ An important question is whether the level of the current imbedded liability of a fund should be explicitly disclosed to a potential taxable investor in that fund.

⁷ Our computer simulation creates a portfolio that perfectly tracks the S&P500 index each month. We use detailed security-level information on dividends, price return and index constituent weights each period. Our accounting tracks the average cost basis of each security. Portfolio evaluation and index re-balancing is performed each month. We assume no trading costs and hold fractional shares. At the beginning, the portfolio is purchased to precisely match the index. Each month-end we evaluate the portfolio. Dividends received during the month are paid into the portfolio as cash after paying taxes, and are re-invested to reduce tracking. Some securities enter or leave the index based either on index re-constitution or on corporate actions. Securities that leave the index are cashed out, incurring a tax consequence. Taxes are paid from the portfolio, both dividends and realized capital gains. For simplicity and to avoid loss-carryforwards, we assume the investor has other capital gains, which can offset any losses incurred. We credit the portfolio with the value of the tax saving in the case of capital losses. Our simulations use any available cash to reduce turnover and approach the index, but additional transactions may still be needed to obtain perfect tracking.

Data is obtained from what we believe to be reliable sources. We have reconciled our pre-tax price return and dividend return sequences with standard S&P sources. As with all simulations, simplifying assumptions are necessary. For example, we re-balance monthly rather than daily. It is believed that the simplifying assumptions have only a minor effect on the after-tax returns shown.

Tax rates are the maximum marginal federal rates for each period:

	<i>Capital Gains tax rate</i>	<i>Dividend tax rate</i>
1985-1986	20%	50%
1987	28%	38.5%
1988-1990	28%	28%
1991-1992	28%	31%
1993-1996	28%	39.6%

Source: IRS