Should the Equities in the North Carolina State Employees' Pension Fund be Indexed or Actively Managed?

Edward Tower

Duke University

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Edward Tower
Professor of Economics at Duke University
tower@econ.duke.edu
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"In Investing, You Get What You Don't Pay For." John C. Bogle, founding CEO of the Vanguard Company, This is the title of his talk to the World Money Show 2005.

"…money management-is provably what is generously called a zero sum game, which is to say, zero before management fees and transaction costs." Jeremy Grantham (2006, p.3)

Ron Elmer's campaign tee shirt illustrates his proposal to index the NC State Employees' Pension Fund and use the savings for a worthy cause.

1. Introduction

R. Ron Elmer is running for Treasurer of the State of North Carolina. He is aware of Jack Bogle's and Jeremy Grantham's quotes that introduced this paper, which make the point that the high expenses and high turnover associated with active management of portfolios reduce returns. Part of Elmer's platform

[1] Thanks go to Steve Thorpe for facilitating Mr. Elmer's talk at the Research Triangle Bogleheads meeting in November 2015. Elmer's talk stimulated this paper. Thanks go to both of them, John Bayne, Mel Lindauer, Mona Prakash, Jim Shaughyrudt, and Richard Warr for comments on this article. A revised version of this article will be published in *Equilibria,* an on line journal edited by Duke undergraduates. (http://econ.duke.edu/academics/undergraduate/esu/journal).

is to replace active management of stock mutual funds, private equity, real estate funds, real estate partnerships, hedge funds and commodity funds with an index investment strategy, managed in house. He tells me that he doesn't believe real estate even belongs in the portfolio as a separate asset class. The S&P 500 and Wilshire 5000 include REITs and the current bond portfolio of the Pension Fund includes mortgaged based securities.

In this article I estimate what the gain would be, if any, from a strategy which is close to Mr. Elmer's proposal. I ask what the returns would have been if the state had simply invested in Vanguard index funds. Mr. Elmer tells me that he believes that he can do even better than this Vanguard index strategy by managing the stock portfolio in house, so perhaps I have underestimated the gain from his strategy. Should he be elected and manage the stock portfolio in house, I suggest he use a benchmark consisting of Vanguard fund returns. Other pension funds might find comparison with the same benchmark to be useful as well.

Mr. Elmer's phone, email, and campaign web site are:

Tel: 919-749-6737
info@ElmerForTreasurer.com
www.ElmerForTreasurer.com

2. What does this paper do?

North Carolina Department of State Treasurer (2009-2015) reports the returns of the various components of the State of North Carolina Employees' Pension Plan through the second quarter of 2015 as well as year by year returns. These are reproduced in the appendix to this paper. "The NC Retirement Systems Division administers four major retirement systems and several smaller systems and supplemental funds" (State Treasurer, 2015). I work with this collection of retirement funds.

Vanguard is a large company famous for providing low-cost equity and bond index mutual funds. So a strategy worth investigating is the effect of replacing the current management of the NC State Employees' Pension Fund with low-cost Vanguard index funds.

3. What Do The Calculations Show?

Exhibits 1-11 and A3 show the effects of replacing components of the NC State Employees' Pension Fund with index funds from Vanguard. Here is how to read them.

Exhibits A1 and A2 report the data I worked with. They present nominal returns. Large and stable real returns are what pension funds should be concerned with, so all the other exhibits report real returns. "Real" returns are the returns after nominal returns are adjusted for inflation.

The returns of assets that have relatively high returns, low standard deviations of return, and low cumulative falls in value are bolded.

Exhibit 1 shows the impact of replacing the pension plan's "inflation protection" with Vanguard's Inflation-Protected Securities, Admiral Share Class, with Nasdaq ticker VAIPX. The Vanguard fund has higher average returns for each of the 7 time periods ending in mid-2015, a lower standard deviation of real return and a lower maximum cumulative decline in real value.

Throughout the paper I use the Admiral share class of the Vanguard funds. Admiral shares have lower expenses than the corresponding Investment share class, and the hugeness of the NC portfolio means that NC would likely qualify for the lower expenses. The Admiral shares were introduced more recently than the more expensive Investor share classes. When the Admiral share class did not exist for the entire time period, for the pre-Admiral share class period, I used the return for the Investor share class, and increased that return by the 2015 expense ratio of the investor share class minus the 2015 expense ratio of the Admiral share class. This approximates what the return of the Admiral share class would have been if it had existed for the entire time span. The expense ratio of Vanguard's Institutional share class is typically 0.1 % less than that of the Admiral class, and I expect that the NC Pension Fund would qualify for this lower expense ratio. One contributor to the high returns of Vanguard funds is that Vanguard lends out its securities to short sellers and charges for this service. Ron Elmer tells me that the NC State Pension fund does the same, so lending does not account for any of the excess Vanguard returns.

Exhibit 2 illustrates that the investor in inflation protection would have had to invest $1.52 real dollars in mid-2009 to cumulate to one real dollar in mid-2015, whereas the investor in VAIPX would have had to invest only $0.87 real dollars to cumulate to one real dollar in mid-2015. Thus VAIPX has the higher six-year return. This is illustrated in Exhibit 3, which presents the geometric average annual real rate of return for various start dates. This is the return that if prevailed every year until mid-2015 would have yielded the observed cumulative return.

The series start in different years, but all end in mid-2015. To compare recent performance, I show how many real dollars cumulate to one real dollar in mid-2015, rather than how many dollars one dollar at the start cumulates to in mid-2015.

In all of the graphs, the Vanguard values and returns are indicated by the squares and lines in Vanguard's color: crimson.

Exhibits 4, 5, and 6 provide the same analysis for Core Real Estate versus VGSLX, the Vanguard REIT Index Fund, Admiral share class. Over the most recent four years, the geometric average returns of the two are a virtual tie, but over longer periods VGSLX wins. VGSLX has a higher standard deviation of real annual return and a 9.5 percentage point higher maximum cumulative drop in real value than Core Real Estate, but the larger return of VGSLX means that its maximum cumulative three-year drop in real value is less than that of Core Real Estate by 5.1 percentage points. Vanguard only established a REIT in May 1996, so the comparison of the Core Real Estate versus VGSLX dates back only to mid-1996. Mr. Elmer suggests replacing the real estate investments with a broad-based equity investment that includes

REITS, rather than investing in a REIT fund. VTSAX outperformed VGSLX over the last five and ten years, so using VGSLX instead of VTSAX as the alternative to Core Real Estate biases my five and ten year calculations of gains from indexing downward. For the most recent 19-year period, Core Real Estate's average return of 4.425%/year is exceeded again by both VGSLX's 7.96% and VTSAX's return of 5.98%, but here VGSLX (the Vanguard REIT) is the best performer.

Exhibits 7, 8, and 9 provide the same analysis for Public Equity and Private Equity versus VTSAX, Vanguard Total Stock Market Index, Admiral Shares. This Vanguard fund invests in the broad US stock market. Its benchmark is the CRSP US Total Market Index. VTSAX outperforms public equity for each of the time spans to mid-2015. It also outperforms private equity for each of the time spans except mid-2014 to mid-2015. Its maximum cumulative fall in real value and its standard deviation of real return are only a hair larger than those of public equity. It fares worse on these two measures than does private equity but private equity is not valued by the market, so its measured low risk is suspect as discussed in section 6.

Exhibit 10 records the geometric average real returns for the five asset categories over the longest time span for which we have annual returns, and for the same periods, the returns of the corresponding Vanguard funds. The Vanguard return minus the pension fund return is multiplied by the assets in each category at mid-2015 to arrive at the saving from indexation.

I did not analyze Non-Core Real Estate in Exhibits 1 through 9. However, data from the NC Department of State Treasurer reports geometric average nominal returns on Core and Non-Core Real Estate over the 10 years through June 2015 of 5.6%/year and 5.2%/year respectively, so Non-Core underperformed by 0.4%/year. Over the longest period Core Real Estate's real return was 4.42%/year, so for that same period we assume in Exhibit 10's calculation that Non-Core Real Estate's real return was 4.02%/year.

The Inflation Sensitive and Diversifiers category returned 2%/year nominal over the 10 years prior to mid-2015. Over the same period, VAIPX returned 3.63 %/year. After adjusting for inflation, the figures are 0.523%/year and 1.534% per year respectively. I used these figures in Exhibit 10, rather than the figures of Exhibit 1, which produced a difference in favor of indexation of 9.12%/year. This choice makes indexation appear less appealing, but still better than the Inflation Sensitive category. However, the recent abysmal performance of the Inflation Sensitive category should not be ignored.

For the Private Equity, the figures of Exhibit 7 produced a difference in favor of indexation of 5.21% /year. We chose to use the 15-year figure of Appendix A2, again ending in mid-2015, which produced a difference in favor of indexation of 4.15%/year. Again, this choice makes indexation appear less appealing but still better.

I did not analyze the impact of replacing hedge funds with a stock index, becauseI do not have the 2014-2015 report on their return and I do not know what proportion of the pension portfolio they made up at any time. The annual returns of hedge funds in the pension portfolio are listed in Exhibit A2 only for the six years prior to the fiscal year ending in mid-2015. Moreover, there is no report on their return for the fiscal year ending in mid-2015. It may be that the pension fund no longer invests in them. If so, that may be a good thing as their six year geometric average annual real rate of return ending in mid-2014 was -

0.778%/year, while VTSAX's six year geometric average annual real rate of return over the same period was 17.616 %/year.

4. Do the Pension Mangers Make Prescient Asset Reallocations?

Does the pension plan increase the share of its funds in asset classes just before they have high returns relative to other assets? To figure this out, I draw on Exhibit A2's data from mid-1996 through mid-2015. I regress the annual continuously compounded nominal return of the pension fund on the annual continuously compounded nominal returns of the three components of the plan for which we have annual returns: income, equity, and real estate plus a constant term. The returns are expressed as %/year. I use continuously compounded returns for two reasons. First, I assume that the pension plan is rebalanced frequently throughout the year, so, for example, if equities perform well relative to other assets, the pension manager sells equities or invests new funds in bonds to bring the share of the portfolio in equities throughout the year back to its initial level. Second, the geometric average continuously compounded return equals the average continuously compounded return, but that is not true for annualized returns. Thus the average continuously compounded return is meaningful, whereas the average annualized return is not.

We know that the shares of the assets in the pension fund must add up to one, so I constrain the sum of the coefficients on income, equity, and real estate to add to one. The coefficients represent average portfolio shares in the three asset classes. The regression minimizes the sum of the squares of the prediction errors. If the constant term is positive, then we can conclude that the managers increase shares of assets just before they perform relatively well. We use Microsoft solver to perform our constrained regression. Our regression equation is

Pension Return =

0.438*Income Return + 0.483*Equity Return + 0.079*Real Estate Return – 0.312.

This regression tells us that on average the pension fund holds 44% of its assets in bonds (the income return), 48% in equity, and 8% in real estate. These are quite close to the current allocation from Exhibit 10. The regression also tells that the return of the pension fund is 0.312%/ year less than it would be if the asset shares were constant. Thus our point estimate is that managers adjust their asset holdings in the wrong direction, shrinking the allocation to asset classes just before they appreciate, and this drags down the portfolio return by 0.312% per year. The R for the regression, which is the correlation between the actual portfolio returns and the calculated returns is 0.971 (a measure of goodness of fit of the regression). The R square is 0.942.

Another interpretation of the negative constant term is that the other components of the pension fund produce inferior returns to those we put into the regression equation. These other components are the rightmost 9 columns of Exhibit A2, including private equity and hedge funds.

Microsoft Excel's "t-test: paired two sample for means" test tells that the true value of the constant term is negative with a probability of 75.1% and positive with a probability of 24.9%. Thus the coefficient

is not significant at conventional levels, so if the NC Pension strategy stays the same in the future, my best guess is that the future constant term will be negative with that same probability of 75.1%. **The lesson of this calculation is that there is no evidence that managers make prescient asset reallocations.**

5. Andrew Silton and I share frustration that the NC pension fund doesn't provide more orderly data.

It is frustrating that the investment categories in Exhibits A1 and A2 are not identical, and that the Pension Fund does not provide annual returns in Exhibit A2 that correspond to the long periods in Exhibit A1. Stilton is the former Chief Investment Officer of the North Carolina Retirement System. In a June 12, 2015 *News and Observer* article titled "Reform needed to get clearer view of NC pension fund." he explains his frustration. Here are some excerpts from his article:

> For about a month, I've been preparing to write a column based on the detailed performance and fee schedule released by State Treasurer Janet Cowell's office for the North Carolina pension plans. As I've previously written, the total fees came to just under $500 million, an 18 percent increase. Like almost every public pension plan in the country, the increases have been driven by the shift to alternative investments. That's really not news, and the performance and fee data aren't timely, since they cover a period that ended on June 30, 2014. Regrettably, it takes the Treasurer's Office more than 10 months to release information that is available internally within 30 days.
>
> I discovered that the treasurer has constructed any number of windows into the performance, risks and allocations of the pension plan, but the panes are made of frosted glass, distorting the information.
>
> For starters, North Carolina uses a mélange of asset classes and categories. … As pension plans and individual investors have moved into alternative investments, the proper use of asset classes has been distorted by mixing in strategies that hide the true exposures of the investment portfolio.
>
> The good news is that the asset allocation looks like a modestly conservative public pension plan. The bad news is that it is heading deeper and deeper into the world of hedge funds and private equity.

6. Andrew Silton points out that the reported riskiness of private equity is wrong.

> Alternative investments are supposed to represent investment nirvana. Money managers have been promising investors that a mix of private equity and hedge funds will boost returns and reduce risk at the same time. The Cowell's (sic) own risk report shows how badly she is being misled. The pension's risk report for the three-year period that ended in March states that conventional equities have fluctuated by an average of 10.5 percent, while the private equity

has varied by only 3 percent over the same period. This relationship, known as standard deviation, is completely wrong.

Private equity, given its leverage and illiquidity, is 30 percent to 50 percent riskier than public stocks, which is why investors expect higher returns from the asset class. It's no small wonder that the state treasurer is moving more and more money into alternatives. Her risk reports are telling her that opportunistic real estate, credit and inflation have a risk of 3.2 percent, 2.8 percent and 5.7 percent respectively. I'd be tempted to invest in these asset classes and strategies if the risk was only a fraction of plain old stocks.

But that's not the full story. The reason that the risk statistics look so attractive is that the treasurer's consultants and staff are mixing market and accounting data. Actual market movements are being used to measure stock and bond risk, while estimates taken from accounting statements form the basis for measuring the risk of most other investments. Whether you are the fiduciary for one of America's largest pension plans or a small retail investor, there's a good rule to invest by. If a particular investment offers a big reward relative to its risk, the data is distorted and/or the risk isn't being captured by the risk statistic.

7. Would Indexing Make Much Difference to North Carolinians?

Exhibit 10's estimation of the gain from indexing is $781 million per year using the mid-2015 asset figures. More precisely, we should refer to the strategy as Vanguardizing since VAIPX and VGSLX are not index funds, but they share the low expenses, wide diversification and low transactions costs of index funds. However, VTSAX does index the entire stock market.

In order to put this into perspective, we draw on Exhibit 11. This figure translates into a saving of 3.59% of the annual NC State Budget or $82 per capita saving for each North Carolina Resident. Should the savings be allocated to raising teachers' salaries, the saving would amount to $8,031 per teacher per year, which would be an 18.14 % salary increase.

8. What would the gain from indexing be if the future looks like the recent past?

Exhibit A3 asks what the gain from indexing would be if the return differential in the future is the same as in the recent past. That Exhibit records the same calculation procedure as in Exhibit 10, except the returns are those for more recent periods. Over the most recent five years ending in mid-2015 the return differential times mid-2015 assets is $2.492 billion per year, and over the most recent ten years ending in mid-2015 it is $969 million per year. I was initially reluctant to report these numbers because they seem too good to be true. They may reflect the fact that some authors have found that over time index funds have increased their margin of performance over that of managed funds. See, for example, Tower (2009). In any case, they indicate the gains that indexing would have offered in the recent past.

9. NC State's Professor Richard Warr Reaches a Similar Conclusion With a Different Approach

Warr(2016) by looking at management fees, incentive fees and trading costs reaches the conclusion that "the NC Pension Fund could save $500 to $900 Million annually." These figures are in the same range as my estimates of $781 million, $969 million, and $2.492 billion annually.

10. Reckoning with the Deadweight Cost of Tax Collection

Taxes inflict a deadweight cost on the economy, dragging down output. A reasonable measure of the deadweight cost of taxation in the US (the marginal welfare cost of taxation) is that for every extra dollar of taxes collected by the sorts of taxes that are likely to be imposed, there is a deadweight loss of 35%. A selection of estimates of the marginal welfare cost of taxes is presented in the references. Stuart (1984) estimates that for the United States it is between 20.7% and 24.4%% of the tax collected. Ballard *et al.* (1985) estimate it to be between 17% and 56% percent. Judd (1987) finds very high MWC's for the taxation of capital, and Gilbert *et al.* (2011) show how the MWC depends on how the taxes are levied inter-temporally.

Thus, should the pension plan saving be used to shrink the tax schedule, households will gain more than the cut according to the schedule. These are called "dynamic" gains. Moreover, the increase in NC GDP will cause NC tax revenues to rise, partially offsetting the initial tax cut, which means that the reduction in the tax schedule should exceed the pension savings. Even if taxes are not lowered by this proposed reform, the proposed reform may enable the slowing of tax increases.

Similarly, the dynamic gains from increases in productive government expenditure on public goods mean that the benefits to North Carolinians are greater than the extra spending.

11. Cumulative Gains

I have presented the savings over one year from indexation. But these are recurrent gains, not one time gains. Suppose indexation allows an individual just starting her work life to experience a 1 real dollar tax reduction that remains in force every year. If she enters the workforce at age 25 and retires at age 65 how much money will that dollar build to over those 40 years? For real rates of return continuously compounded of 0%/year, 2%/year, 3%/year and 4%/ year, the tax saving cumulates to $40, $49, $61, $77, and $98 real dollars at retirement. Historically the stock market has returned 6% real per year, sometimes referred to as Siegel's constant, after the Wharton Professor Jeremy Siegel. However, given today's lower real interest rates and high stock market valuation, we can expect lower returns today. A 4% real return from the stock market and a 1% real return from the bond market are perhaps reasonable guesses. Thus the family who saves $82 real dollars in taxes per year, if it invests in stocks in a tax-sheltered account could expect to have $8,118 extra real dollars at retirement. If it invests in bonds in a tax-sheltered account it could expect $4018 extra real dollars at retirement. Should the savings be realized in higher teachers' salaries, the retirement assets would be calculated in the same way. For example, in the unlikely event that all the saving were passed on to teachers, the $8,031 real dollars if invested in the stock market each year, would cumulate to $794,069 real dollars at retirement, and if invested in bonds, would cumulate to $393,519.

12. Conclusion

These calculations are rough, in part because of lack of better data. However, they, along with the logic of Andrew Silton, do suggest that Mr. Elmer's proposal for indexation of the Equity part of the portfolio of North Carolina is worth serious consideration. It would be useful to perform similar calculations for other states too.

13. Summary

Our various calculations (from Exhibits 10 and A3) indicate indexing the equity part of the NC Pension fund would have increased returns by approximately $781 million per year (in the 3 years ending mid-2015), $2.492 billion per year (last 5 years to mid-2015), and $969 million per year (last 10 years to mid-2015). This is an increase in the return by between 0.87%/year and 2.78%/year.

The most conservative of these estimates translates into a saving of 3.59% of the annual NC State Budget or $82 per capita saving for each North Carolina Resident. Should the savings be allocated to raising teachers' salaries, the saving would amount to $8,031 per teacher per year, which would be a 18.14 % salary increase. These are annual figures. The gain of $781 million per year translates into $7.810 billion over a decade. The likely growth of the pension plan makes this figure a slight underestimate.

14. Postscript: Reply to Comments

Ron Elmer did not win the Democratic primary. Elmer's share of the vote in the Democratic Primary for Treasurer was 41.5% to Dan Blue III's 58.5%.

Since I posted this paper as a working paper, it has stimulated a column by Mel Lindauer in *Forbes* (http://www.forbes.com/sites/thebogleheadsview/2016/03/15/indexing-state-pension-funds/#2bd0c546399a), an article by Tim Storrock in *Fundfire*, an article by Dan Solin in the *Huffington Post* (http://www.huffingtonpost.com/dan-solin/a-plan-to-stop-the-pensio_b_9398016.html), and mention in the on-line version of *Esquire* magazine (http://www.esquire.com/news-politics/politics/news/a44616/north-carolina-bathroom-law-education-funding/?src=social-email). Tim Sorrock wisely sought comment by the NC State Treasurer's office on the paper. Kevin SigRist of North Carolina's Department of State Treasurer office made two crucial comments on the paper. The public equities consist of both US and foreign equities, and in recent years the foreign stock market has had lower returns than the US market. Thus, a benchmark that better captured the Fund's style would be a mix of US and foreign stocks.

He also tells me that the inflation protection category includes energy stocks and commodities, so using the Vanguard Inflation Protected Treasury fund as the benchmark for that category does not capture the style of assets that the pension fund invested in.

I had wondered how it was that the "investment grade fixed income" category generated such high returns. He tells me that "High returns in the investment grade fixed income asset class have been due to two factors:

1. It has a longer duration (~8 years) which makes it particularly sensitive to falling/rising market interest rates. The long duration, compared to broad indices like the Barclays Aggregate Bond Index, is largely a result of our asset liability analysis and ability to ride-out shorter-term mark-to-market volatility.
2. The asset class maintains an allocation of around 30% U.S. Government issued bonds. During "risk-off" environments, the market flight to quality causes outsized returns. This portion of the asset class is also viewed as an important hedge against the risk of deflation."

What should readers take away from the interchange? To some extent this paper compares apples and oranges. The study shows that several of the simple indexing strategies used in this study out-returned the roughly comparable asset categories in the pension fund. Other indexing strategies would have under-returned. I hope to extend this paper to explore with better data whether indexing strategies with the same risk profile would have out-returned the State of North Carolina Employees' Pension Plan. I am grateful to the N.C. Treasurer's office for promising me additional data. I think it would be helpful for these data to be regularly posted on the NC State Treasury's web site, and that it is desirable to encourage all state pension funds to provide at least the same level of transparency that is required of mutual funds.

References

Ballard, C., J. B. Shoven, and J. Whalley. 1985. "General Equilibrium Computations of the Marginal Welfare Costs of Taxes in the United States." *The American Economic Review*. Vol 75, No. 1. March. Pp..128-138.

Gilbert, J., K. Limananda, T. Takahiko, E. Tower and A. Tuncharoenlarp. 2011. "The Deadweight Cost of War: An Illustrative CGE. *The Economics of Peace and Security Journal*. Vol. 6, No. 2.

Grantham, Jeremy. 2006. The end of an era. *GMO Quarterly Letter*. January 3. hpps/www.GMO.com.

Judd, K.L. 1987. "The Welfare Cost of factor Taxation in a Perfect-Foresight Model." *Journal of Political Economy.* Vol . 95, No. 4 (July), pp. 675-709.

North Carolina Education. 2016.
http://teaching.about.com/od/ProfilesInEducation/a/North-Carolina-Education.htm

North Carolina Department of State Treasurer. 2009-2015. "NCRS Quarterly Update as of June 30, 2015 through 2009."(https://www.nctreasurer.com/inv/Investment Reports/NCRSQuartertlyUpdate-Q2-2015.pdf.

State Treasurer. 2015. "The State Treasurer's Annual Report to the People of North Carolina, fiscal year 2013-2014." (https://www.nctreasurer.com/inside-the-department/Reports/NCDST_AnnualReport-FY2013-2014.pdf)

Stilton, A. 2015. "Reform needed to get clearer view of NC pension fund." *News and Observer*. June 12. (http://www.newsobserver.com/news/business/article23891137.html#storylink=cpy).

Stuart, C. 1984. "Welfare Costs of Additional Tax Revenue in the United States." *American Economic Review*. Vol 74, No. 2, pp. 352-362.

Tower, E. 2009. "Performance of Actively Managed Versus Index Funds: the Vanguard Case" Chapter 12 of *Mutual Funds: Portfolio Structures, Analysis, Management, and Stewardship*, edited by John A. Haslem. Hoboken: Wiley 2009. Pp. 211-236. Working paper version: http://public.econ.duke.edu/Papers//PDF/0419CHAPTER_12_TOWER_working_paper_version.pdf

Warlters, M. and Emmanuelle Auriol. 2007. "The Marginal Cost of Public funds in Developing Countries: An Application to 38 African Countries." The World Bank, 3rd October. http://idei.fr/doc/wp/2007/marginal_cost.pdf

Warr, R.S. 2016. "The Cost Savings Associated With Indexing the NC Pension Fund." January http://financeclippings.blogspot.com/2016/02/why-i-am-supporting-ron-elmer-for.html?m=1

Exhibit 1. Inflation Protection vs VAIPX. VAIPX Returns higher with lower standard deviation of real return.

Cumulative Real Value			Geometric Avg Return %/yr	
Year	Inflation Protection	VAIPX	Inflation Protection	VAIPX
2015	1	1		
2014	1.09	**1.02**	-8.11	**-1.94**
2013	1.03	**1.00**	-1.30	**0.19**
2012	1.08	**1.07**	-2.42	**-2.17**
2011	1.22	**0.97**	-4.95	**0.76**
2010	1.52	**0.94**	-7.99	**1.32**
2009	1.52	**0.86**	-6.74	**2.48**
Std deviation of annual real return %			8.12	**5.76**
Largest cumulative decline in value %			34.22	**6.72**

Exhibit 2. Inflation Protection vs VAIPX. Cumulative Real Value. Fraction of Mid 2015 Value. Low means high subsequent return.

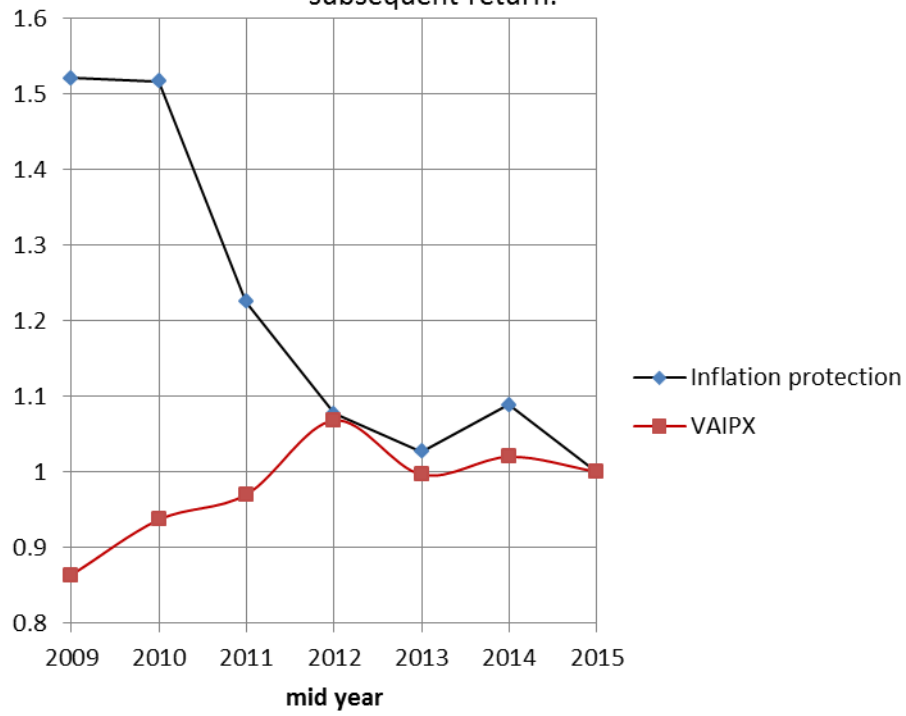

Exhibit 3. Inflation Protection VAIPX Geometric Average Annual Real Rate of Return through Mid 2015. %/yr.

Exhibit 4. Core Real Estate vs VGSLX. VGSLX Returns higher with higher standard deviation of real return and higher maximum % fall in real value.

	Cumulative Real Value		Geometric Avg Return %/yr	
Year	Core Real Estate	VGSLX	Core Real Estate	VGSLX
2015	1	1		
2014	**0.94**	0.96	**6.87**	3.69
2013	**0.85**	0.87	**8.30**	7.30
2012	**0.78**	0.81	**8.53**	7.23
2011	0.74	**0.73**	7.92	**8.22**
2010	0.65	**0.56**	9.13	**12.16**
2009	0.78	**0.37**	4.14	**18.21**
2008	1.13	**0.63**	-1.68	**6.86**
2007	1.09	**0.77**	-1.05	**3.40**
2006	0.96	**0.70**	0.41	**4.00**
2005	0.80	**0.61**	2.25	**5.00**
2004	0.73	**0.48**	2.92	**6.98**
2003	0.70	**0.39**	3.02	**8.14**
2002	0.70	**0.40**	2.78	**7.36**
2001	0.70	**0.35**	2.54	**7.85**
2000	0.65	**0.29**	2.88	**8.56**
1999	0.60	**0.29**	3.22	**8.01**
1998	0.54	**0.32**	3.65	**6.88**
1997	0.47	**0.31**	4.22	**6.82**
1996	0.44	**0.23**	4.42	**7.96**
Std deviation of annual real return %			**8.53**	15.19
Largest cumulative decline in value %			**42.63**	52.10
Largest 3 year decline in value %			28.11	**22.99**

Exhibit 5. Core Real Estate vs VGSLX. Cumulative Real Value. Fraction of Mid 2015 Value. Low means high subsequent return.

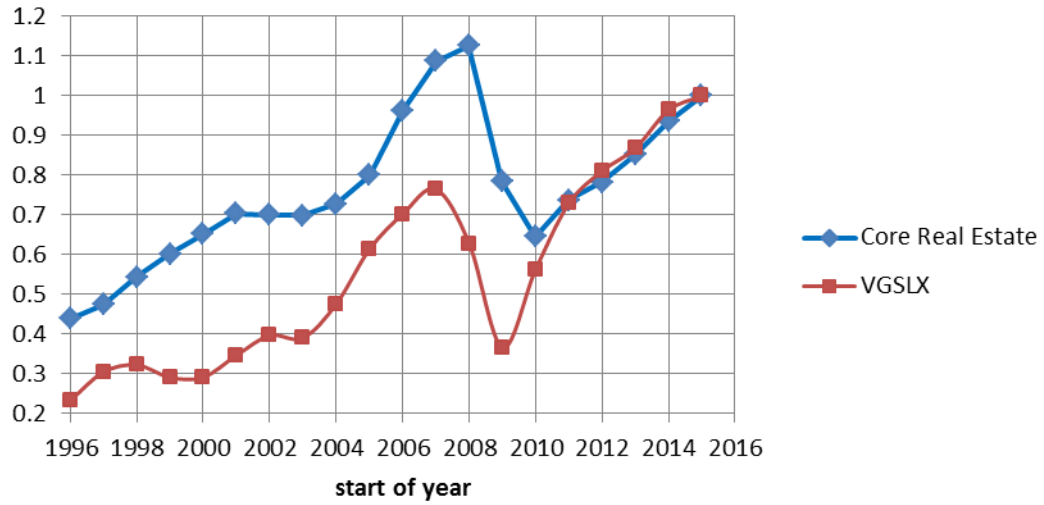

Exhibit 6. Core Real Estate vs VGSLX. Geometric Average Annual Real Rate of Return thru Mid 2015. %/yr.

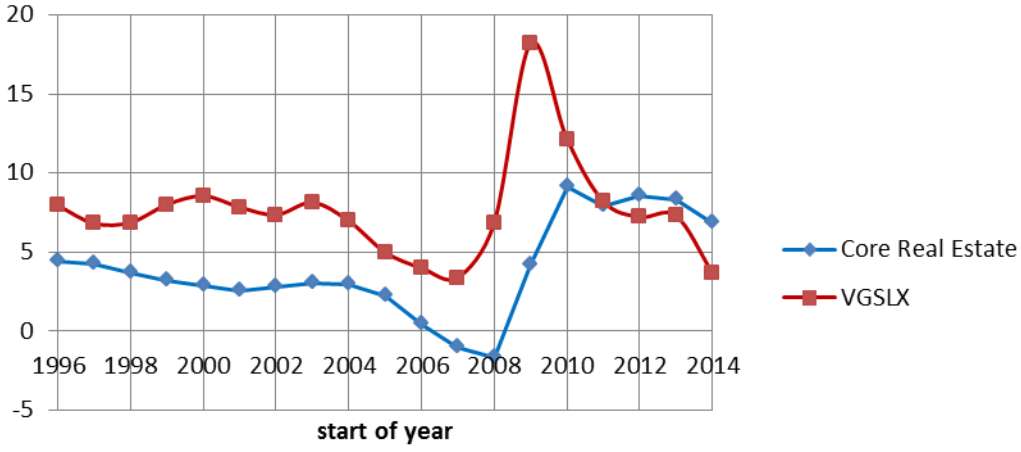

Exhibit 7. Public Equity and Private Equity vs VTSAX. Public Equity returns less than VTSAX by 0.65%/yr with a hair lower std deviation mid 1995 to mid 2015. VTSAX returns higher than either public or private equity with lower std deviation of return than public equity but higher than private equity from 2008 to mid 2015. VTSAX and public equity have almost the same max cumulative fall in real value.

	Cumulative Real Value			Geometric Avg Return %/yr		
Year	Public Equity	Private Equity	VTSAX	Public Equity	Private Equity	VTSAX
2015	1	1	1			
2014	0.99	**0.91**	0.93	0.98	**9.46**	7.04
2013	0.81	0.79	**0.76**	11.05	12.62	**14.57**
2012	0.69	0.76	**0.64**	12.91	9.65	**16.14**
2011	0.75	0.72	**0.62**	7.42	8.42	**12.50**
2010	0.59	0.71	**0.49**	10.95	7.02	**15.45**
2009	0.53	0.64	**0.42**	11.30	7.79	**15.34**
2008	0.72	0.80	**0.57**	4.85	3.23	**8.44**
2007	0.84		**0.68**	2.16		**4.93**
2006	0.72		**0.58**	3.69		**6.22**
2005	0.67		**0.55**	4.11		**6.13**
2004	0.63		**0.52**	4.36		**6.07**
2003	0.52		**0.44**	5.57		**6.99**
2002	0.53		**0.45**	5.00		**6.36**
2001	0.63		**0.54**	3.38		**4.44**
2000	0.74		**0.66**	2.05		**2.79**
1999	0.68		**0.62**	2.43		**2.99**
1998	0.58		**0.53**	3.25		**3.79**
1997	0.47		**0.42**	4.29		**4.94**
1996	0.37		**0.33**	5.33		**5.98**
1995	0.31		**0.27**	6.04		**6.69**
Std deviation of annual real return 2008-2015 %				17.39	**10.89**	16.46
Std deviation of annual real return 1995-2015 %				**15.55**		15.91
Largest cumulative decline in value 2008-2015 %				26.76	**20.36**	25.10
Largest cumulative decline in value 1995-2015 %				**37.580**		37.583

Exhibit 8. Public and Private Equity vs VTSAX. Cumulative Real Value as a Fraction of Mid 2015 Value. Low means high subsequent return.

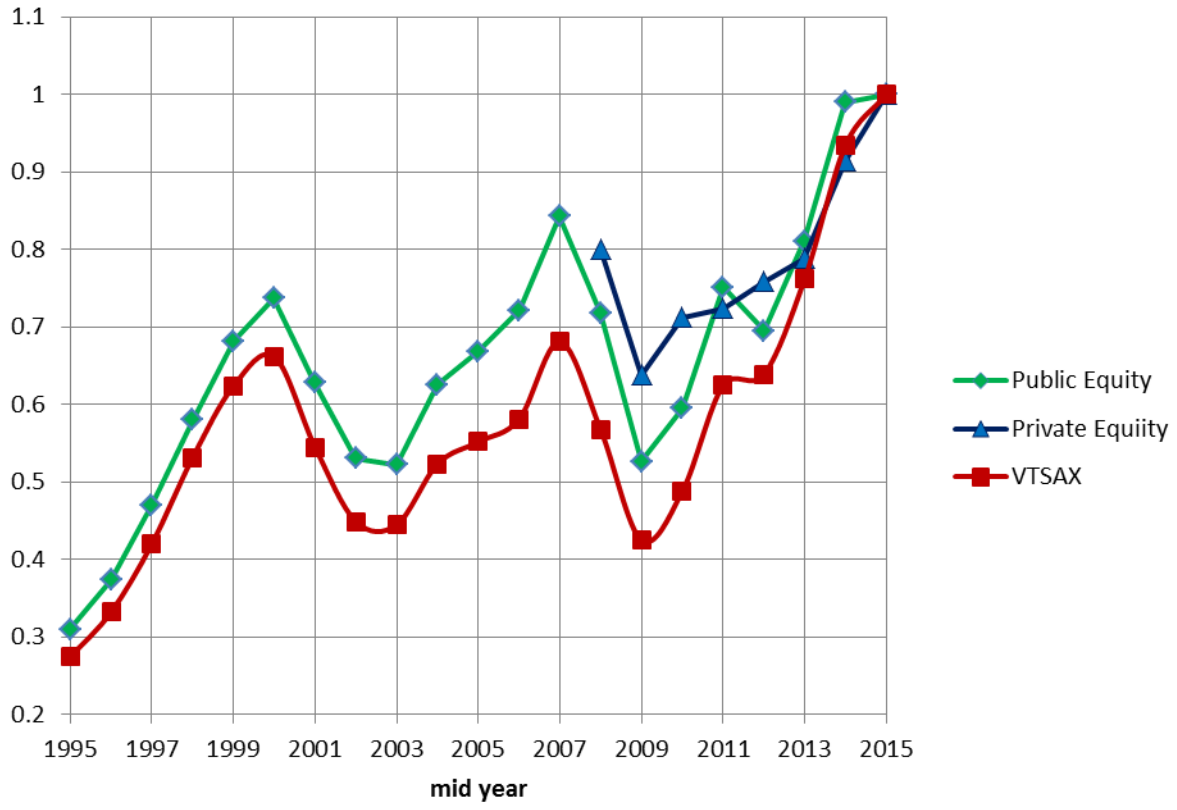

Exhibit 9. Public and Private Equity vs VTSAX. Geometric Average Annual Real Rate of Return thru Mid 2015. %/yr.

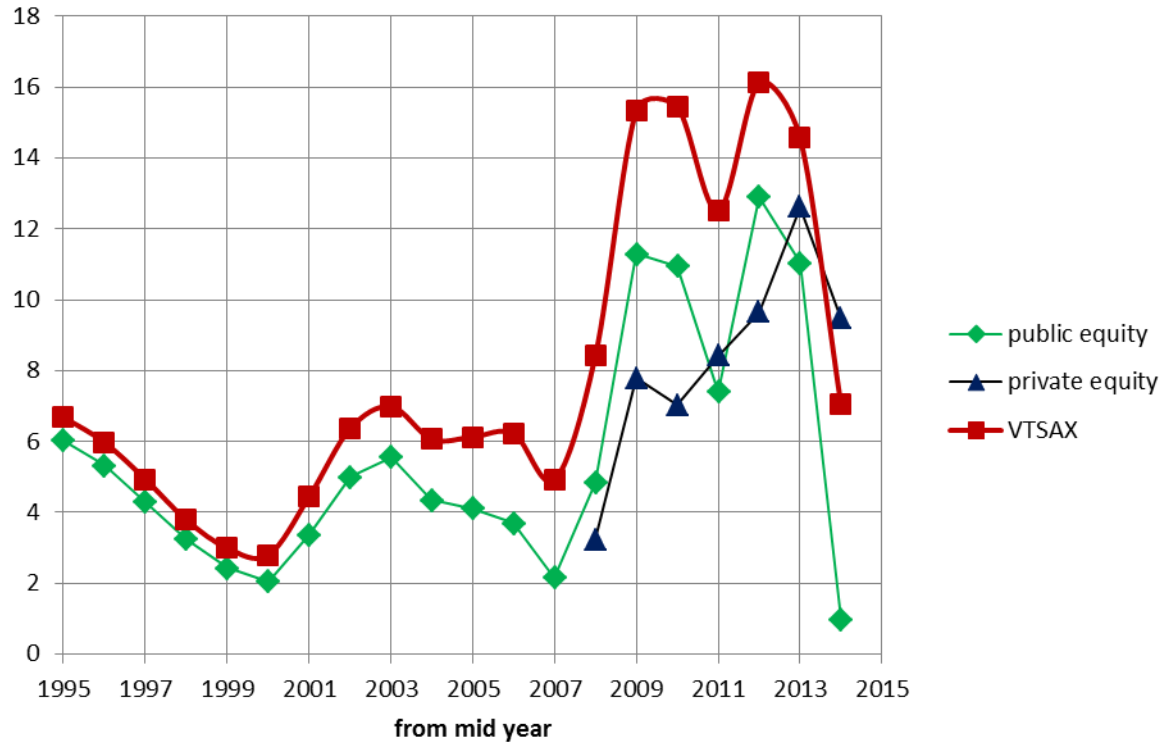

Exhibit 10. Saving from Indexation in $						
Pension Component	Start year for Return	Vanguard Return %	Pension Return %	Vanguard Excess	Assets Mid 2015	Saving $ Million
Inflation Protection	2005	1.58	-0.06	1.64	$4,764	$78
Core Real Estate	1996	7.96	4.42	3.54	$3,594	$127
Public Equity	1995	6.69	6.04	0.65	$39,792	$259
Private Equity	2000	2.79	-1.36	4.15	$4,174	$173
Non-Core Real Estate	1995	7.96	4.02	3.94	$3,653	$144
Total Savings						$781

Exhibit 11. Saving from Indexation in perspective	
NC Budget 2015	$21.74 billion
# of public school teachers in NC (from NC Education, 2016)	97,308
Average teacher salary (from NC Education, 2016)	$42,557
Population of NC	9.5 million
Savings as a fraction of the NC budget	3.59%
Saving per teacher	$8,031
Saving as fraction of teacher salary	18.87%
Saving per capita	$82

Appendix

Exhibit A1. From North Carolina Department of State Treasurer						
North Carolina Retirement System Quarterly Update 2nd Quarter 2015						
Asset Type	Market Value ($000)	Return (expressed in %)				
		1 yr	3 yr	5 yr	10 yr	15 yr
Public Equity	39,792,298	1.1	14.5	13.0	6.3	4.3
Private Equity	4,174,260	9.6	11.1	11.0	8.9	0.8
Non-Core Real Estate	3,652,612	19.6	15.0	14.6	5.2	x
Opportunistic Fixed Income	5,438,220	-0.5	9.7	8.9	x	x
Investment Grade Fixed Income	25,412,562	2.1	2.4	4.8	5.6	6.8
Cash	1,060,871	0.5	x	x	x	x
Inflation Sensitive	4,763,776	-8.0	-1.1	-4.8	2.0	x
Core Real Estate	3,594,338	7.0	10.3	11.9	5.6	x
Multi-Strategy	1,686,815	1.5	11.8	10.3	6.2	x
Total Pension Plan	89,575,752	2.3	9.1	9.5	6.2	5.5

Exhibit A2. North Carolina Retirement System Pension Investment Returns

Annual Returns for Fiscal Years Ending 6/30

Year	Total Pension	Fixed Income	Public Equities	Real Estate	Alter-natives	Private Equity	Hedge Funds	Credit Strat-egies	Inflation Pro-tection	Cash	Non-Core Real Estate	Oppor-tunistic Fixed Income	Multi-Strat-egy
2015	**2.3%**	2.10%	1.10%	7.00%		9.60%	no report	no report	-8.00%	0.50%	19.60%	-0.50%	1.50%
2014	**15.88%**	6.04%	24.66%	12.03%		18.27%	6.58%	12.90%	8.21%	0.46%			
2013	**9.52%**	-0.75%	18.78%	10.90%		5.76%	6.49%	17.45%	-2.95%				
2012	**2.21%**	11.66%	-5.98%	7.88%	reported	6.55%	-6.52%	0.37%	-10.67%				
2011	**18.48%**	5.30%	30.76%	18.16%	no	5.24%	6.84%	15.79%	-16.35%				
2010	**11.97%**	13.20%	14.30%	-16.70%	longer	12.90%	10.30%	8.40%	0.80%				
2009	**-14.22%**	7.60%	-27.80%	-31.40%		-21.50%	-16.80%						
2008	**-2.07%**	8.40%	-10.50%	8.70%	7.60%								
2007	**14.82%**	6.50%	19.90%	15.90%	13.70%								
2006	**7.23%**	-2.60%	12.60%	25.60%	14.10%								
2005	**9.85%**	10.26%	9.58%	12.67%	3.59%								
2004	**12.01%**	-1.08%	23.73%	7.56%	5.57%								
2003	**7.56%**	15.65%	0.51%	1.97%	-5.83%								
2002	**-4.04%**	9.96%	-14.67%	0.59%	-20.34%								
2001	**-2.04%**	11.67%	-12.01%	11.31%	-35.91%								
2000	**9.03%**	4.50%	12.25%	12.49%	109.43%								
1999	**10.74%**	1.06%	19.71%	12.96%	26.76%								
1998	**19.44%**	14.56%	25.63%	16.35%	12.84%								
1997	**8.90%**	8.46%	28.78%	10.47%	20.19%								
1996	**n/a**	8.96%	23.87%	6.28%	25.04%								

Exhibit A3. Saving from Indexation in $, Calculated from 5 and 10 Year Trailing Returns

Pension Component		last 5 years to mid 2015				last 10 years to mid 2015			
All returns are average geometric real returns in %/yr	Pension assets mid 2015 $ Million	Vanguard Return	Pension Return	Excess Vanguard Return	Projected Saving $ Million	Vanguard Return	Pension Return	Excess Vanguard Return	Projected Saving $ Million
Public Equity	39,792	15.45	10.97	4.48	1,783	6.13	4.15	1.98	789
Private Equity	4,174	15.45	9.01	6.44	269	6.13	6.70	-0.56	-24
Non-Core Real Estate	3,653	12.16	12.54	-0.38	-14	5.00	3.07	1.93	70
Inflation Sensitive	4,763	1.32	-6.51	7.83	373	1.58	-0.06	1.64	78
Core Real Estate	3,594	12.16	9.89	2.27	82	5.00	3.46	1.53	55
Total	89,576				**2,492**				**969**