

Tax Efficient Asset Management: Evidence from Equity Mutual Funds

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July, 2018

Motivation

- Investment taxes on equity securities in the United States have a substantial impact on the performance of long-term investors.
 - Dividends are taxed at the dividend tax rate.
 - Capital gains realized after holding a position for less than one year are taxed at the short-term capital gains tax rate.
 - Capital gains realized after holding a position for more than one year are taxed at the long-term capital gains tax rate.
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Taxation of Mutual Funds

- Mutual funds are required to “pass-through” the dividends and the realized capital gains to their shareholders to avoid being subject to the corporate tax.
- Taxable fund investors are required to pay taxes on fund dividends and capital gains distributions, even if they do not liquidate their fund positions.
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Tax-Efficient Asset Management Strategies

Investors can reduce the tax burdens by:

- Deferring the realization of capital gains and accelerating the realization of capital losses.
 - Difference between long- and short-term capital gains tax rate
 - Present value of tax
 - Step-up of the cost basis at death
- Avoiding securities that are heavily taxed.
 - Invest in tax-exempt municipal bonds.
 - Avoid stocks with high non-qualified dividends.

Tax avoidance strategies constrain the investment opportunities of investors and might reduce the before-tax performance of investors.

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Examples of Tax Avoidance Strategies: The Window Tax from England of 1696



Source:

<http://www.nationalarchives.gov.uk/education/resources/georgian-britain-age-modernity/window-tax/>

Examples of Tax Avoidance Strategies: The “Beard Token” from Russia



Source: https://en.wikipedia.org/wiki/Beard_tax

Examples of Tax Avoidance Strategies: Import Duty on Cars in Ukraine



Source: <http://www.business-opportunities.biz/2014/05/07/cutting-cars-in-half-to-avoid-import-duties/>

Related Literature

Tax Capitalization with Heterogeneous Investors:

- Miller and Modigliani (1961), Brennan (1970), Miller and Scholes (1978), Auerbach and King (1983), Dybvig and Ross (1986), Allen, Bernardo, and Welch (2000), and Sialm (2009).

Tax Implications of Mutual Fund Management:

- Dickson and Shoven (1995), Barclay, Pearson, and Weisbach (1998), Dickson, Shoven, and Sialm (2000), Gibson, Safieddine, and Titman (2000), Bergstresser and Poterba (2002), Huddart and Narayanan (2002), Christoffersen, Geczy, Musto, and Reed (2006), Ivkovic and Weisbenner (2008), and Sialm and Starks (2012).

Tax Implications of Investment Styles:

- Bergstresser and Pontiff (2013), Israel and Moskowitz (2012), Sialm and Sosner (2018).

Outline

- Introduction
- Theoretical Model
- Data and Summary Statistics
- Determinants of Tax Burdens
- Mutual Fund Performance
- Conclusions

Theoretical Model with Decreasing Returns to Scale

- Extension of Berk and Green (2004) taking into account heterogeneous tax clienteles.
 - Two mutual funds subject to decreasing returns to scale
 - Two tax clienteles

Model with Risk-Neutral Agents

- Two investment strategies with decreasing returns to scale ($f' < 0$):

$$r_H = f^H(w_H)$$

$$r_L = f^L(w_L)$$

- Two tax clienteles

- Tax-exempt investors (X): $\tau_H^X = \tau_L^X = 0$

- Taxable investors (T): $\tau_H^T > \tau_L^T > 0$

- The total amount invested by both investor types in both investment strategies is normalized to 1:

$$w_H^T + w_L^T + w_H^X + w_L^X = 1.$$

- The proportion of assets held by tax-exempt investors amounts to: λ .
- Investors are risk-neutral and cannot hold short positions ($w_f^f \geq 0$).

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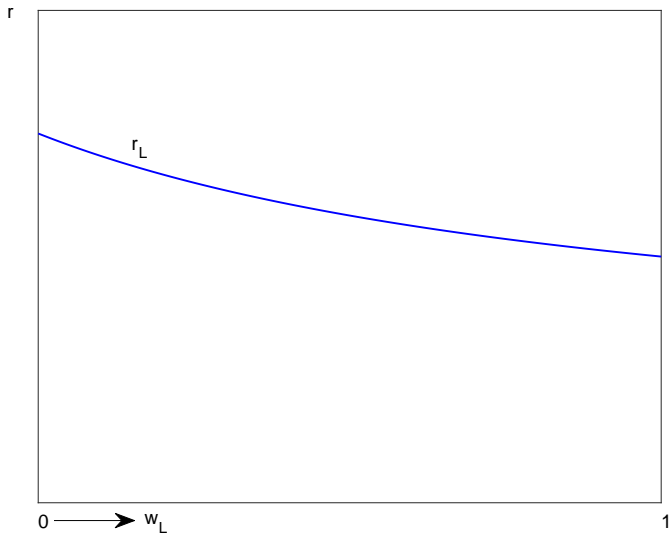
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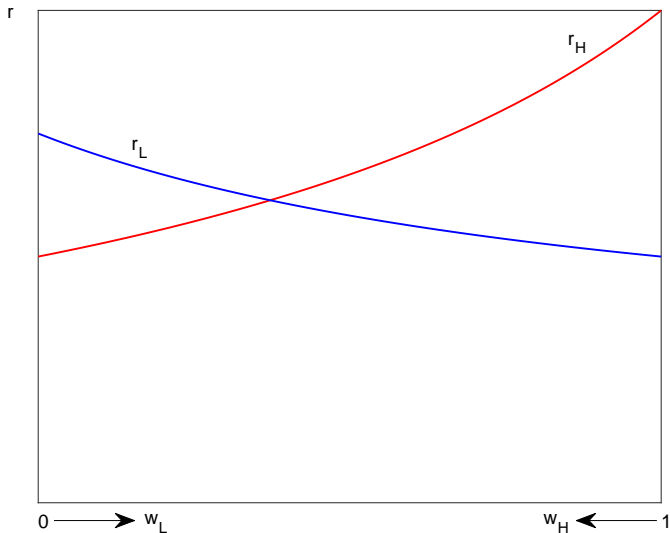
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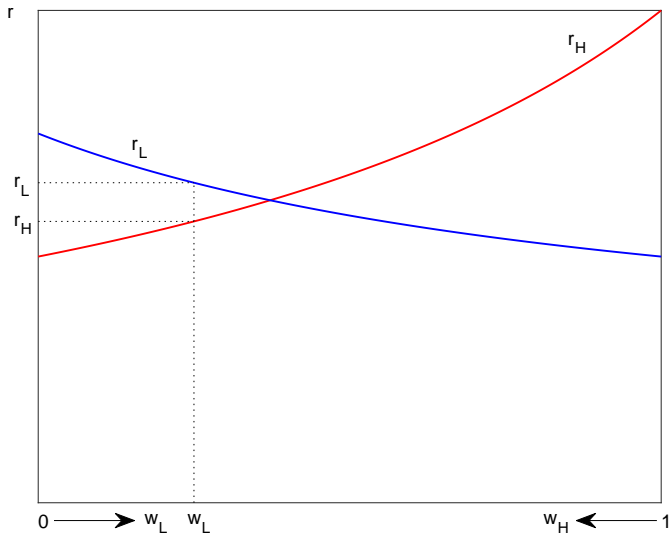
Before-Tax Return of Strategy H

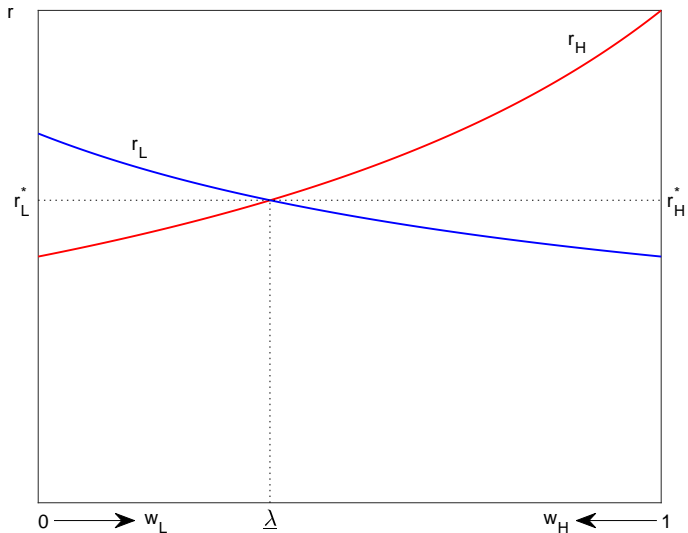


Before-Tax Returns of Strategies H and L

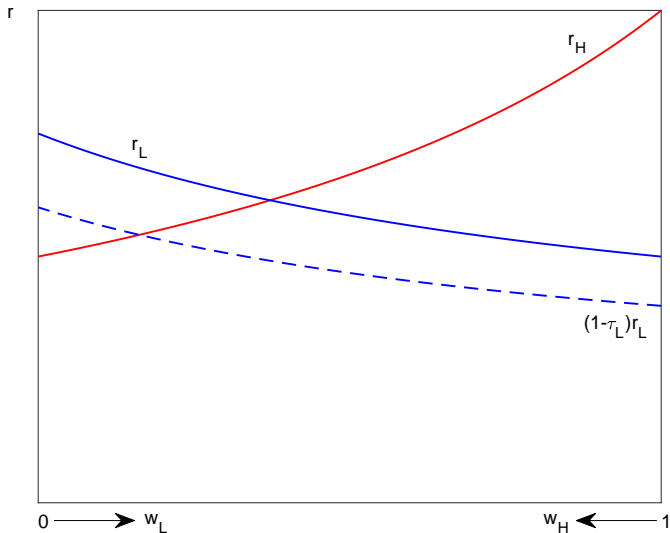


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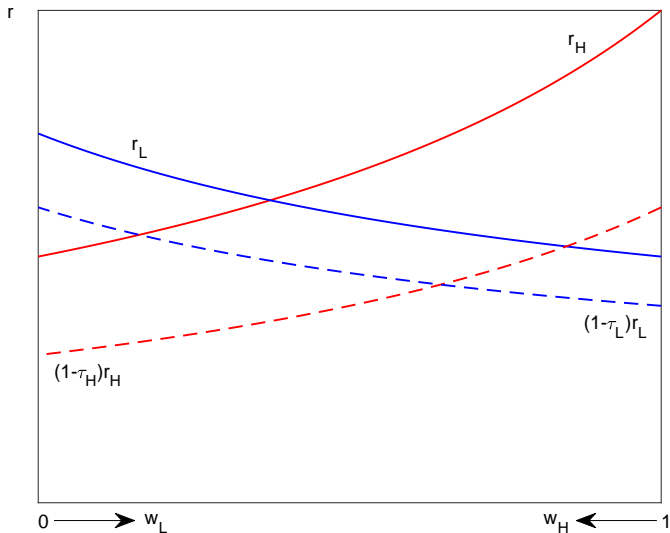


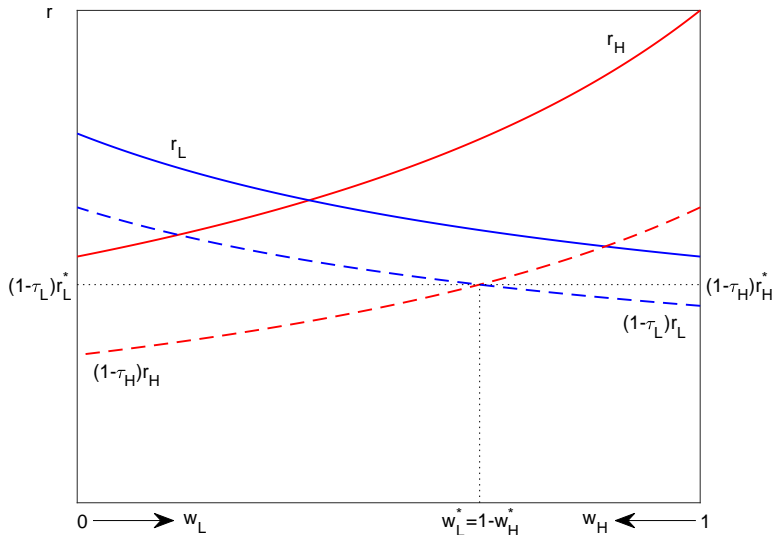
Equilibrium with Tax-Exempt Investors ($\lambda = 1$)

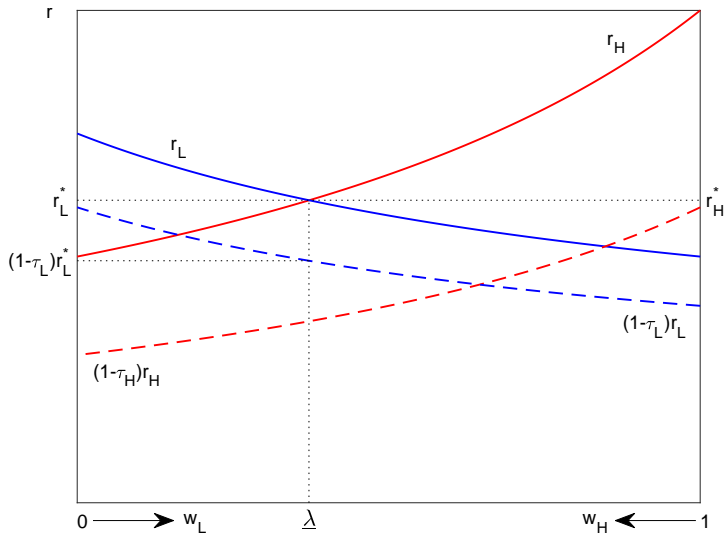
After-Tax Return of Strategy H

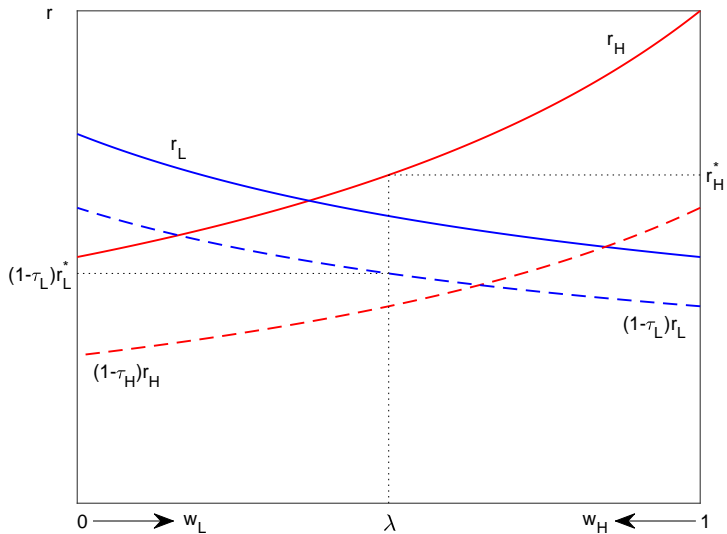


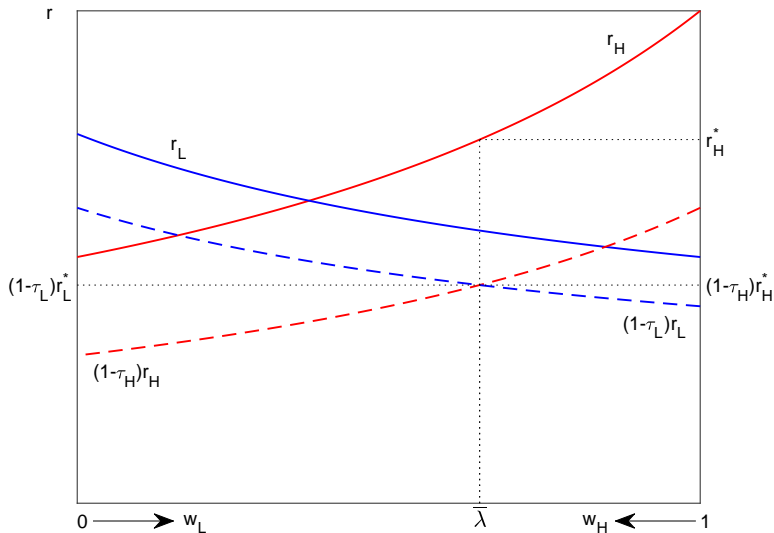
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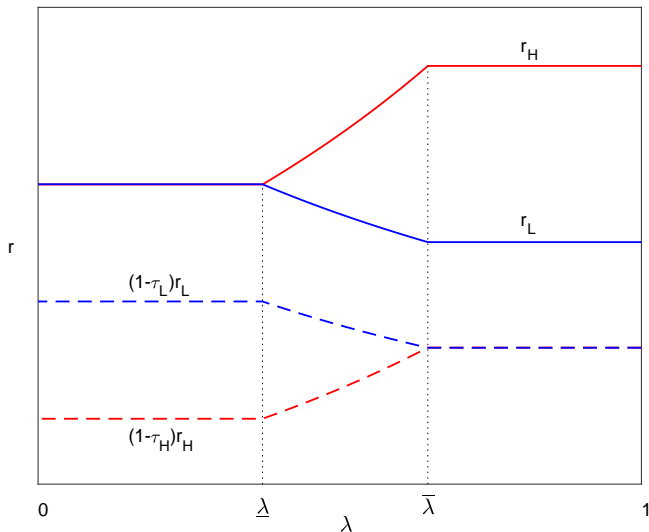
Equilibrium with Taxable Investors ($\lambda = 0$)

Case 1: $\lambda \leq \underline{\lambda}$ 

Case 2: $\underline{\lambda} < \lambda < \bar{\lambda}$ 

Case 3: $\bar{\lambda} \leq \lambda$ 

Returns for Different Clientele Distributions



Model Conclusions

- Risk-Neutral Investors:
 - Before-tax returns are equalized if tax-exempt investors are dominant (i.e., $\lambda \geq \bar{\lambda}$).
 - After-tax returns are equalized if taxable investors are dominant (i.e., $\lambda \leq \underline{\lambda}$).
 - Neither before- nor after-tax returns are equalized at intermediate clientele distributions (i.e., $\underline{\lambda} < \lambda < \bar{\lambda}$).

Data Sources

- U.S. equity mutual funds between 1990-2016 using the CRSP mutual fund database.
- Mutual fund equity holdings using the Thomson-Reuters fund holdings database.
- Top marginal tax rates on dividends and capital gains.
- Defined Contribution fund assets from *Pensions & Investments*.

Tax Burden

- Before-Tax Return:

$$\begin{aligned}
 R_{f,t}^{BT} &= \frac{DIV_{f,t} + SCG_{f,t} + LCG_{f,t} + P_{f,t} - P_{f,t-1}}{P_{f,t-1}} \\
 &= Y_{f,t}^{DIV} + Y_{f,t}^{SCG} + Y_{f,t}^{LCG} + Y_{f,t}^{UCG},
 \end{aligned}$$

- After-Tax Return:

$$\begin{aligned}
 R_{f,t}^{AT} &= (1 - \tau_t^{DIV}) Y_{f,t}^{DIV} + (1 - \tau_t^{SCG}) Y_{f,t}^{SCG} + (1 - \tau_t^{LCG}) Y_{f,t}^{LCG} + Y_{f,t}^{UCG} \\
 &= R_{f,t}^{BT} - \tau_t^{DIV} Y_{f,t}^{DIV} - \tau_t^{SCG} Y_{f,t}^{SCG} - \tau_t^{LCG} Y_{f,t}^{LCG},
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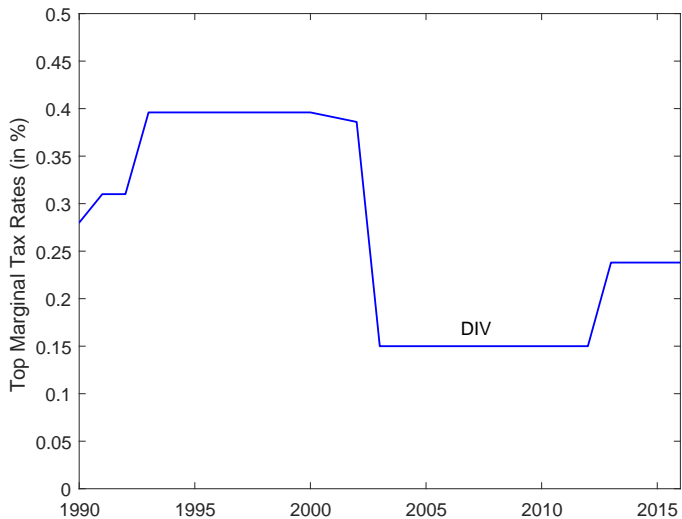
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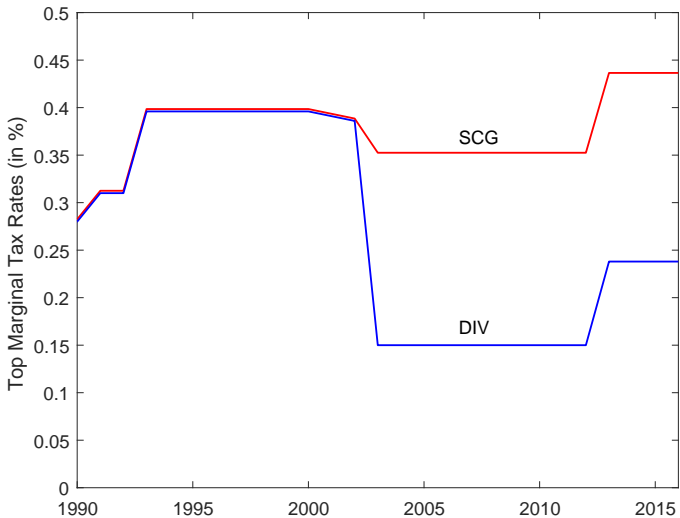
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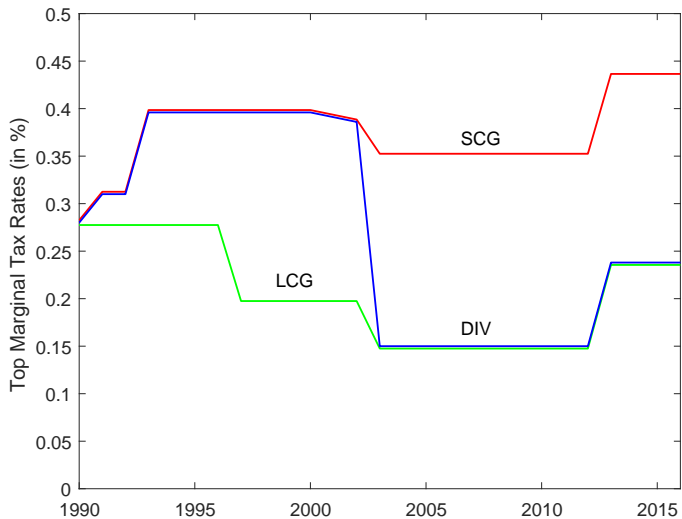
Marginal Tax Rates



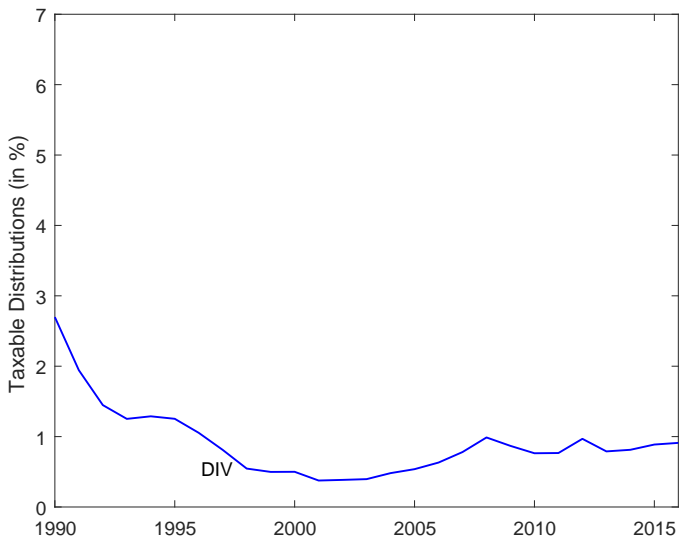
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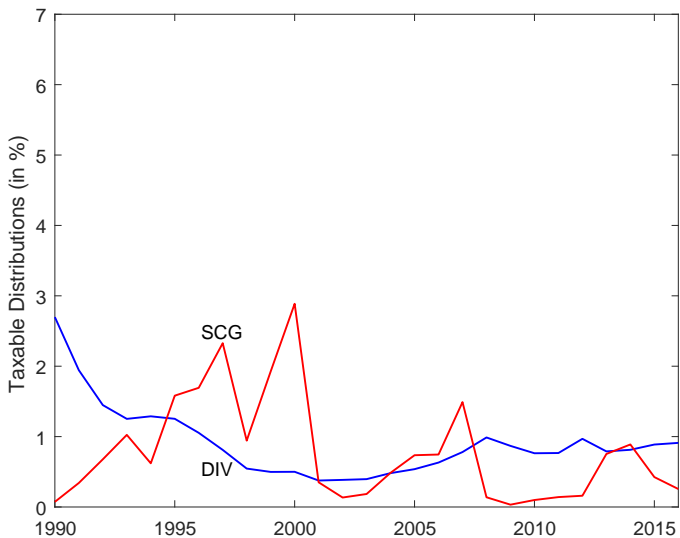
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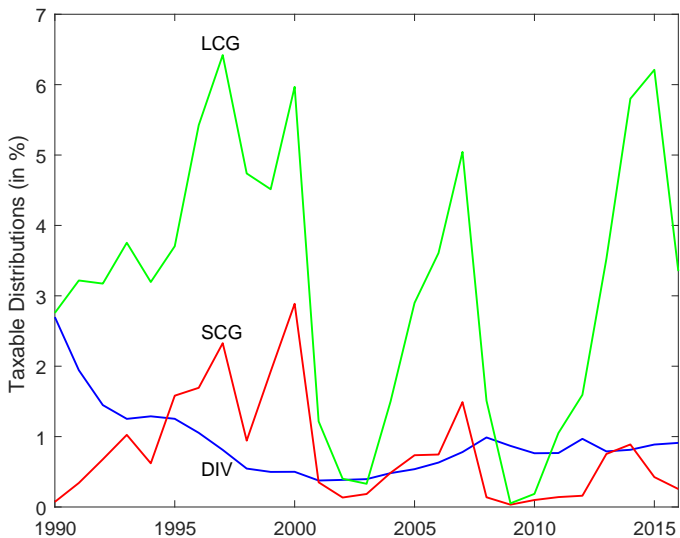
Average Fund Distributions



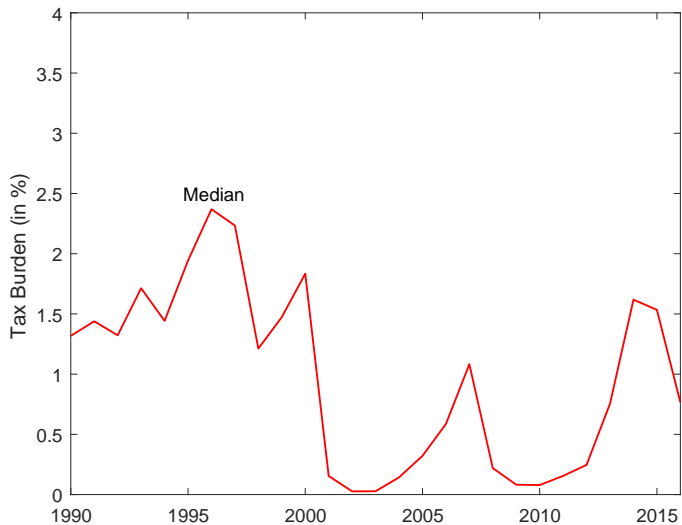
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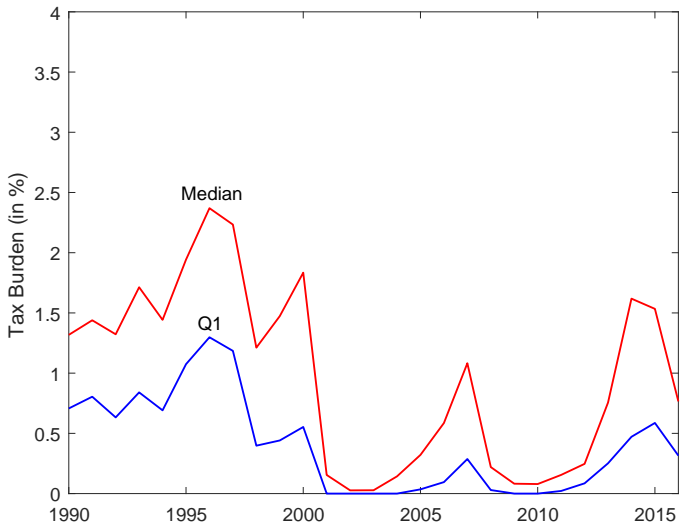
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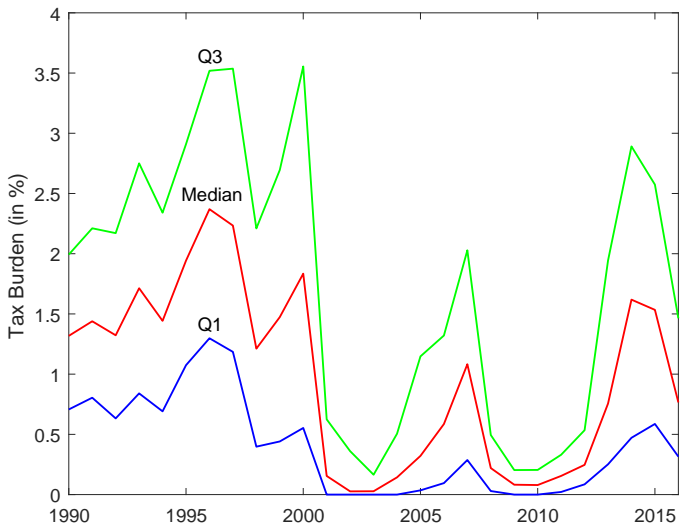
Cross-Sectional Tax Burdens



Cross-Sectional Tax Burdens



Cross-Sectional Tax Burdens



Summary Statistics

	All Equity Mutual Funds	Actively- Managed Mutual Funds	Tax- Managed Funds	Index Mutual Funds
Tax Burden (in % per year)	1.08	1.11	0.32	0.66
Before-Tax Return (in % per year)	8.49	8.51	5.79	8.11
After-Tax Return (in % per year)	7.39	7.38	5.45	7.44
Before-Tax Market-Adjusted Return (in % per year)	-0.41	-0.46	-0.17	0.41
After-Tax Market-Adjusted Return (in % per year)	-1.50	-1.59	-0.51	-0.26
Total Distributions (in % per year)	4.44	4.54	1.51	3.01
Dividend Yield (in % per year)	0.78	0.74	0.55	1.37
Short-Term Capital Gains Yield (in % per year)	0.73	0.77	0.08	0.22
Long-Term Capital Gains Yield (in % per year)	2.93	3.03	0.88	1.43
Expense Ratio (in % per year)	1.14	1.19	1.10	0.40
DC Ratio (in % of TNA)	27.26	26.18	2.54	40.15
Number of Observations	48,567	45,318	654	3,249

Determinants of Tax Burden

	Tax Burden _t	
Size Score _{t-1}	-0.0911*** (0.0120)	-0.1017*** (0.0121)
Value Score _{t-1}	0.1852*** (0.0266)	0.2436*** (0.0259)
Momentum Score _{t-1}	0.0223 (0.0258)	-0.0074 (0.0264)
Flow _{t-1}		-0.0895*** (0.0041)
Flow Std Dev _{t-1}		0.0173*** (0.0044)
Turnover _{t-1}		0.0456*** (0.0129)
Expense Ratio _{t-1}		-0.1046*** (0.0234)
Log Fund Size _{t-1}		0.0115* (0.0067)
Fund Age _{t-1}		0.0223 (0.0141)
ST CG Overhang _{t-1}		0.0402*** (0.0038)
LT CG Overhang _{t-1}		0.0000 (0.0008)
Observations	38,867	37,119
R-squared	0.0071	0.0534

Determinants of Tax Burden

	Tax Burden _t		Short-Term Capital Gains _t		Long-Term Capital Gains _t		Dividend Distributions _t	
Size Score _{t-1}	-0.0911*** (0.0120)	-0.1017*** (0.0121)	-0.1938*** (0.0217)	-0.1618*** (0.0210)	-0.3828*** (0.0412)	-0.4556*** (0.0400)	0.1988*** (0.0128)	0.1547*** (0.0126)
Value Score _{t-1}	0.1852*** (0.0266)	0.2436*** (0.0259)	0.3039*** (0.0396)	0.2554*** (0.0361)	-0.2619*** (0.1005)	0.1606* (0.0954)	0.6378*** (0.0291)	0.5958*** (0.0289)
Momentum Score _{t-1}	0.0223 (0.0258)	-0.0074 (0.0264)	0.2937*** (0.0453)	0.0808* (0.0476)	-0.0026 (0.0893)	0.1387 (0.0891)	-0.3635*** (0.0315)	-0.2858*** (0.0327)
Flow _{t-1}		-0.0895*** (0.0041)		-0.0294*** (0.0063)		-0.3672*** (0.0140)		-0.0017 (0.0032)
Flow Std Dev _{t-1}		0.0173*** (0.0044)		-0.0061 (0.0075)		0.0869*** (0.0143)		0.0064* (0.0034)
Turnover _{t-1}		0.0456*** (0.0129)		0.2562*** (0.0391)		-0.2764*** (0.0333)		-0.0060 (0.0078)
Expense Ratio _{t-1}		-0.1046*** (0.0234)		-0.0792** (0.0354)		0.3019*** (0.0852)		-0.5670*** (0.0364)
Log Fund Size _{t-1}		0.0115* (0.0067)		0.0019 (0.0089)		0.0579** (0.0259)		0.0133* (0.0077)
Fund Age _{t-1}		0.0223 (0.0141)		-0.0289 (0.0243)		0.1330*** (0.0500)		-0.0506*** (0.0179)
ST CG Overhang _{t-1}		0.0402*** (0.0038)		0.0721*** (0.0076)		0.0721*** (0.0073)		-0.0072** (0.0028)
LT CG Overhang _{t-1}		0.0000 (0.0008)		-0.0146*** (0.0011)		0.0351*** (0.0044)		-0.0026*** (0.0005)
Observations	38,867	37,119	38,867	37,119	38,867	37,119	38,867	37,119
R-squared	0.0071	0.0534	0.0141	0.0691	0.0066	0.0731	0.1236	0.1795

Fund Performance

- Performance of funds sorted according to their prior tax efficiency.
 - Raw Performance
 - Abnormal Performance Measures
 - Subperiods
 - Different Horizons
 - Distribution Types
 - Return Decomposition
 - DC Ratio
 - Fund Style
- Performance of self-designated tax-efficient funds.
 - Funds Matched by Family and Name
 - Funds Matched by Family and Investment Style
 - Funds Matched by Family, Investment Style, and Fund Size

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Fund Performance: Raw Performance Measure

	Before-Tax Return _t	
Tax Burden _{t-1}	-0.3347*** (0.0909)	-0.4701*** (0.0933)
Return _{t-1}		0.0757*** (0.0091)
Expense Ratio _{t-1}		-1.2867*** (0.1338)
Log(TNA _{t-1})		-0.1561*** (0.0320)
Age _{t-1}		-0.1321 (0.0871)
Turnover _{t-1}		-0.0228 (0.1226)
Flow _{t-1}		-0.3168*** (0.0260)
Observations	37,427	35,412
R-squared	0.0147	0.0315

Fund Performance: Raw Performance Measure

	Before-Tax Return _t		Tax Burden _t	
Tax Burden _{t-1}	-0.3347*** (0.0909)	-0.4701*** (0.0933)	0.4017*** (0.0205)	0.3692*** (0.0206)
Return _{t-1}		0.0757*** (0.0091)		0.0181*** (0.0016)
Expense Ratio _{t-1}		-1.2867*** (0.1338)		-0.0160 (0.0181)
Log(TNA _{t-1})		-0.1561*** (0.0320)		0.0147*** (0.0047)
Age _{t-1}		-0.1321 (0.0871)		-0.0820*** (0.0124)
Turnover _{t-1}		-0.0228 (0.1226)		0.0204** (0.0096)
Flow _{t-1}		-0.3168*** (0.0260)		-0.0807*** (0.0035)
Observations	37,427	35,412	37,427	35,412
R-squared	0.0147	0.0315	0.0795	0.1216

Fund Performance: Raw Performance Measure

	Before-Tax Return _t		Tax Burden _t		After-Tax Return _t	
Tax Burden _{t-1}	-0.3347*** (0.0909)	-0.4701*** (0.0933)	0.4017*** (0.0205)	0.3692*** (0.0206)	-0.7364*** (0.0843)	-0.8393*** (0.0866)
Return _{t-1}		0.0757*** (0.0091)		0.0181*** (0.0016)		0.0576*** (0.0087)
Expense Ratio _{t-1}		-1.2867*** (0.1338)		-0.0160 (0.0181)		-1.2707*** (0.1319)
Log(TNA _{t-1})		-0.1561*** (0.0320)		0.0147*** (0.0047)		-0.1708*** (0.0321)
Age _{t-1}		-0.1321 (0.0871)		-0.0820*** (0.0124)		-0.0501 (0.0849)
Turnover _{t-1}		-0.0228 (0.1226)		0.0204** (0.0096)		-0.0432 (0.1183)
Flow _{t-1}		-0.3168*** (0.0260)		-0.0807*** (0.0035)		-0.2361*** (0.0262)
Observations	37,427	35,412	37,427	35,412	37,427	35,412
R-squared	0.0147	0.0315	0.0795	0.1216	0.0158	0.0276

Fund Performance: Raw Performance Measure with Fund Fixed Effects

	Before-Tax Return _t		Tax Burden _t		After-Tax Return _t	
Tax Burden _{t-1}	-0.7636*** (0.0935)	-0.9642*** (0.0976)	-0.9270*** (0.0958)	-1.1038*** (0.0996)	0.1634*** (0.0165)	0.1396*** (0.0157)
Return _{t-1}		0.0040 (0.0082)		-0.0133 (0.0084)		0.0173*** (0.0013)
Expense Ratio _{t-1}		-0.4277 (0.4001)		-0.2094 (0.3980)		-0.2182*** (0.0519)
Log(TNA _{t-1})		-2.4639*** (0.0963)		-2.5604*** (0.0951)		0.0965*** (0.0130)
Age _{t-1}		0.2831 (0.2746)		0.4780* (0.2734)		-0.1948*** (0.0410)
Turnover _{t-1}		0.2846 (0.2608)		0.2552 (0.2516)		0.0294** (0.0147)
Flow _{t-1}		-0.4803*** (0.0293)		-0.3945*** (0.0295)		-0.0857*** (0.0039)
Observations	37,199	35,184	37,199	35,184	37,199	35,184
R-squared	0.0052	0.0562	0.0067	0.0565	0.0109	0.0537

Fund Performance: Abnormal Performance Measures (Daily; 1999-2016)

	Before-Tax Alpha		Tax Burden Alpha		After-Tax Alpha	
Raw Returns	-0.3347*** (0.0909)	-0.4701*** (0.0933)	0.4017*** (0.0205)	0.3692*** (0.0206)	-0.7364*** (0.0843)	-0.8393*** (0.0866)
CAPM	-0.3473*** (0.0918)	-0.4477*** (0.0902)	0.3841*** (0.0258)	0.3618*** (0.0251)	-0.7313*** (0.0841)	-0.8095*** (0.0829)
Fama-French 3 Factor	-0.2583*** (0.0831)	-0.3419*** (0.0754)	0.3623*** (0.0214)	0.3426*** (0.0206)	-0.6205*** (0.0745)	-0.6845*** (0.0673)
Carhart 4 Factor	-0.2897*** (0.0814)	-0.3673*** (0.0763)	0.3551*** (0.0206)	0.3358*** (0.0196)	-0.6448*** (0.0731)	-0.7031*** (0.0687)
Fama-French 5 Factor	-0.1444* (0.0871)	-0.2013*** (0.0768)	0.3618*** (0.0219)	0.3418*** (0.0211)	-0.5063*** (0.0791)	-0.5431*** (0.0712)
Hou-Xue-Zhang 4 Factor	-0.3053*** (0.0870)	-0.3902*** (0.0802)	0.3710*** (0.0252)	0.3501*** (0.0244)	-0.6763*** (0.0775)	-0.7402*** (0.0722)
GISW-Manipulation-Proof Measure	-0.3016*** (0.1009)	-0.4082*** (0.1062)	0.4436*** (0.0325)	0.4089*** (0.0335)	-0.7452*** (0.0893)	-0.8171*** (0.0918)
Berk-Binsbergen Alpha	-0.2392*** (0.0850)	-0.2776*** (0.0756)	0.3600*** (0.0249)	0.3447*** (0.0240)	-0.5993*** (0.0731)	-0.6223*** (0.0656)
Berk-Binsbergen Value Added	-2.4186** (1.0347)	-3.1901*** (1.0179)	2.3977*** (0.4486)	0.8716** (0.3575)	-4.8163*** (1.0925)	-4.0616*** (1.0334)
Controls	No	Yes	No	Yes	No	Yes

Fund Performance: Subperiods

	Before-Tax Return _t		Tax Burden _t		After-Tax Return _t	
	1990-2002	2003-2016	1990-2002	2003-2016	1990-2002	2003-2016
Tax Burden _{t-1}	-0.6462*** (0.1476)	-0.3386*** (0.0828)	0.2556*** (0.0333)	0.4804*** (0.0168)	-0.9018*** (0.1346)	-0.8190*** (0.0862)
Return _{t-1}	0.1599*** (0.0128)	-0.0936*** (0.0088)	0.0239*** (0.0023)	0.0084*** (0.0010)	0.1360*** (0.0122)	-0.1019*** (0.0087)
Expense Ratio _{t-1}	-1.4538*** (0.2774)	-1.1130*** (0.1334)	-0.1360*** (0.0405)	0.0548*** (0.0178)	-1.3178*** (0.2765)	-1.1678*** (0.1342)
Log(TNA _{t-1})	-0.5128*** (0.0781)	0.0328 (0.0312)	-0.0065 (0.0097)	0.0263*** (0.0050)	-0.5063*** (0.0778)	0.0065 (0.0315)
Age _{t-1}	-0.1135 (0.1564)	0.0286 (0.0858)	-0.0704*** (0.0254)	-0.0703*** (0.0118)	-0.0431 (0.1520)	0.0989 (0.0863)
Turnover _{t-1}	0.0513 (0.2248)	-0.0538 (0.1391)	0.0979*** (0.0291)	-0.0047 (0.0054)	-0.0466 (0.2310)	-0.0490 (0.1392)
Flow _{t-1}	-0.6686*** (0.0541)	-0.0315 (0.0228)	-0.1381*** (0.0066)	-0.0393*** (0.0032)	-0.5305*** (0.0544)	0.0078 (0.0231)
Observations	11,751	23,661	11,751	23,661	11,751	23,661
R-squared	0.0647	0.0376	0.1373	0.1357	0.0534	0.0386

Fund Performance: Different Horizons

	Before-Tax Return _t			Tax Burden _t			After-Tax Return _t		
1-Yr Tax Burden _{t-1}	-0.3775*** (0.0591)			0.3055*** (0.0170)			-0.6830*** (0.0563)		
5-Yr Tax Burden _{t-1}	-0.4634*** (0.0883)			0.3700*** (0.0220)			-0.8334*** (0.0876)		
10-Yr Tax Burden _{t-1}	-0.3321*** (0.0979)			0.3633*** (0.0177)			-0.6954*** (0.0996)		
Return _{t-1}	0.0822*** (0.0079)	0.0717*** (0.0077)	0.0469*** (0.0098)	0.0153*** (0.0015)	0.0179*** (0.0016)	0.0169*** (0.0017)	0.0669*** (0.0077)	0.0538*** (0.0078)	0.0300*** (0.0100)
Expense Ratio _{t-1}	-1.1966*** (0.1286)	-1.2595*** (0.1295)	-1.3750*** (0.1487)	-0.0299 (0.0185)	0.0050 (0.0207)	0.0003 (0.0266)	-1.1667*** (0.1266)	-1.2644*** (0.1277)	-1.3753*** (0.1485)
Log(TNA _{t-1})	-0.1478*** (0.0318)	-0.1101*** (0.0313)	-0.0931*** (0.0343)	0.0096** (0.0048)	0.0207*** (0.0052)	0.0195*** (0.0063)	-0.1574*** (0.0318)	-0.1307*** (0.0314)	-0.1126*** (0.0346)
Age _{t-1}	-0.2532*** (0.0808)	-0.1195 (0.0886)	-0.0357 (0.1074)	-0.0349*** (0.0114)	-0.0801*** (0.0148)	-0.0778*** (0.0189)	-0.2183*** (0.0795)	-0.0395 (0.0869)	0.0422 (0.1059)
Turnover _{t-1}	-0.0324 (0.1144)	-0.1293 (0.1280)	-0.2107 (0.1388)	0.0382** (0.0171)	0.0162 (0.0104)	-0.0002 (0.0085)	-0.0706 (0.1074)	-0.1456 (0.1213)	-0.2104 (0.1356)
Flow _{t-1}	-0.2925*** (0.0252)	-0.2762*** (0.0263)	-0.2817*** (0.0311)	-0.0634*** (0.0034)	-0.0965*** (0.0041)	-0.1146*** (0.0058)	-0.2291*** (0.0254)	-0.1796*** (0.0265)	-0.1671*** (0.0318)
Observations	36,666	31,084	22,328	36,666	31,084	22,328	36,666	31,084	22,328
R-squared	0.0311	0.0283	0.0236	0.1369	0.1024	0.0861	0.0288	0.0241	0.0188

Fund Performance: Distribution Types

	Before-Tax Return _t		Tax Burden _t		After-Tax Return _t	
Long-Term Gains _{t-1}	-0.1337*** (0.0212)	-0.1717*** (0.0195)	0.1045*** (0.0034)	0.0971*** (0.0035)	-0.2382*** (0.0208)	-0.2688*** (0.0193)
Short-Term Gains _{t-1}	0.0097 (0.0695)	-0.0069 (0.0691)	0.1052*** (0.0186)	0.0943*** (0.0177)	-0.0956 (0.0585)	-0.1012* (0.0589)
Dividends _{t-1}	-0.1421** (0.0711)	-0.3801*** (0.0676)	0.1116*** (0.0154)	0.1087*** (0.0169)	-0.2537*** (0.0700)	-0.4889*** (0.0636)
Return _{t-1}		0.0741*** (0.0089)		0.0185*** (0.0016)		0.0556*** (0.0086)
Expense Ratio _{t-1}		-1.4513*** (0.1368)		-0.0101 (0.0202)		-1.4413*** (0.1347)
Log(TNA _{t-1})		-0.1617*** (0.0320)		0.0143*** (0.0046)		-0.1760*** (0.0321)
Age _{t-1}		-0.0662 (0.0829)		-0.0955*** (0.0117)		0.0293 (0.0822)
Turnover _{t-1}		-0.0870 (0.1132)		0.0392*** (0.0130)		-0.1263 (0.1066)
Flow _{t-1}		-0.3326*** (0.0260)		-0.0765*** (0.0035)		-0.2561*** (0.0260)
Observations	37,427	35,412	37,427	35,412	37,427	35,412
R-squared	0.0155	0.0331	0.0826	0.1247	0.0172	0.0299

Return Decomposition

To obtain some indications of the causes for the differences in performance, we decompose the before-tax returns into different components:

- Decomposition of Fund Returns (R) into Holdings Return (RH), Expense Ratio (EXP), and Return Gap (RG) based on Kacperczyk, Sialm, and Zheng (2008):

$$R_{f,t}^{BT} = RH_{f,t} - EXP_{f,t} + RG_{f,t}$$

- Decomposition of Holdings Return (RH) into Characteristic Selectivity (CS), Characteristic Timing (CT), and Average Style (AS) based on Daniel, Grinblatt, Titman, and Wermers (1997):

$$R_{f,t}^{BT} = CS_{f,t} + CT_{f,t} + AS_{f,t} - EXP_{f,t} + RG_{f,t}$$

- Decomposition of Return Gap (RG) into Interim Trading Benefits (ITB) and Trading Costs (TC) using trading cost measures of Edelen, Evans, and Kadlec (2013):

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Performance Decomposition by Tax Burden

$$\begin{aligned}
 R_{f,t}^{BT} &= RH_{f,t} - EXP_{f,t} + RG_{f,t} \\
 &= CS_{f,t} + CT_{f,t} + AS_{f,t} - EXP_{f,t} + ITB_{f,t} - TC_{f,t}
 \end{aligned}$$

Portfolio	Characteristic Selectivity _t	Characteristic Timing _t	Average Style _t	Expense Ratio _t	Trading Costs _t	Interim Trading Benefits _t
Tax Burden _{t-1}	-0.1925*** (0.0528)	-0.0084 (0.0314)	-0.2690*** (0.0622)	-0.0002 (0.0009)	0.1336*** (0.0139)	0.1200** (0.0605)
Return _{t-1}	0.0727*** (0.0072)	0.0425*** (0.0036)	-0.0244*** (0.0055)	-0.0008*** (0.0001)	-0.0032*** (0.0007)	-0.0233*** (0.0061)
Expense Ratio _{t-1}	-0.0372 (0.0869)	-0.0296 (0.0551)	-0.2314*** (0.0865)	0.9425*** (0.0059)	0.2720*** (0.0328)	0.2869*** (0.0815)
Log(TNA _{t-1})	-0.0667*** (0.0214)	0.0137 (0.0146)	-0.0538** (0.0221)	-0.0054*** (0.0005)	0.1129*** (0.0079)	0.1249*** (0.0191)
Age _{t-1}	-0.0147 (0.0530)	-0.0106 (0.0341)	-0.0486 (0.0556)	0.0067*** (0.0014)	-0.0941*** (0.0177)	-0.1656*** (0.0486)
Turnover _{t-1}	0.1410*** (0.0525)	0.1719*** (0.0336)	0.0143 (0.0468)	0.0084*** (0.0018)	0.4844*** (0.0474)	0.4968*** (0.0781)
Flow _{t-1}	-0.0884*** (0.0172)	-0.0293*** (0.0095)	-0.1353*** (0.0189)	-0.0045*** (0.0004)	-0.0068** (0.0032)	-0.0179 (0.0151)
Observations	34,555	34,555	34,555	34,555	34,555	33,213
R-squared	0.0166	0.0194	0.0286	0.9348	0.4837	0.0553

Fund Performance: Defined Contribution Ratio (1997-2012)

	Before-Tax Return _t		Tax Burden _t		After-Tax Return _t	
Tax Burden _{t-1}	-0.7158*** (0.2662)	-0.7663*** (0.2648)	0.3795*** (0.0353)	0.3519*** (0.0317)	-1.0954*** (0.2610)	-1.1182*** (0.2620)
DC Ratio _{t-1}	-0.0057 (0.0067)	-0.0087 (0.0073)	0.0035** (0.0017)	0.0027* (0.0014)	-0.0092 (0.0066)	-0.0115 (0.0071)
TB _{t-1} × DC _{t-1}	0.0169*** (0.0063)	0.0154** (0.0070)	-0.0016 (0.0017)	-0.0011 (0.0013)	0.0185*** (0.0061)	0.0165** (0.0067)
Return _{t-1}		0.0695*** (0.0196)		0.0203*** (0.0040)		0.0492** (0.0199)
Expense Ratio _{t-1}		-1.1498*** (0.3459)		-0.0252 (0.0565)		-1.1246*** (0.3466)
Log(TNA _{t-1})		-0.3150*** (0.0798)		-0.0072 (0.0121)		-0.3078*** (0.0805)
Age _{t-1}		-0.0870 (0.1958)		-0.0314 (0.0228)		-0.0556 (0.1958)
Turnover _{t-1}		-0.3316 (0.2941)		-0.0209 (0.0230)		-0.3106 (0.2950)
Flow _{t-1}		-0.3313*** (0.0690)		-0.0880*** (0.0103)		-0.2432*** (0.0691)
Observations	6,167	6,135	6,167	6,135	6,167	6,135
R-squared	0.0267	0.0406	0.0877	0.1365	0.0239	0.0327

Performance Predictability by Fund Style

	Before-Tax Return _t		Tax Burden _t		After-Tax Return _t	
Tax Burden _{t-1}	-0.3525*** (0.0876)	-0.4830*** (0.0894)	0.4135*** (0.0200)	0.3763*** (0.0171)	-0.7660*** (0.0808)	-0.8592*** (0.0859)
Size Score _{t-1}	-1.2290*** (0.0554)	-1.2306*** (0.1167)	-0.0648*** (0.0085)	-0.0642** (0.0276)	-1.1642*** (0.0539)	-1.1664*** (0.0998)
Value Score _{t-1}	1.2469*** (0.1395)	1.3738*** (0.1937)	0.0912*** (0.0195)	0.0091 (0.0291)	1.1557*** (0.1389)	1.3647*** (0.1940)
Momentum Score _{t-1}	-0.3271** (0.1628)	-0.2992 (0.2283)	0.0305* (0.0177)	-0.0715*** (0.0263)	-0.3575** (0.1612)	-0.2277 (0.2257)
TB _{t-1} × Size _{t-1}		-0.0282 (0.1014)		0.0091 (0.0250)		-0.0373 (0.0832)
TB _{t-1} × Value _{t-1}		-0.1355 (0.1385)		0.0735*** (0.0224)		-0.2090 (0.1384)
TB _{t-1} × Momentum _{t-1}		-0.0901 (0.1214)		0.0566*** (0.0195)		-0.1466 (0.1206)
Return _{t-1}		0.0753*** (0.0092)		0.0181*** (0.0017)		0.0573*** (0.0089)
Expense Ratio _{t-1}		-1.2131*** (0.1283)		-0.0040 (0.0174)		-1.2092*** (0.1264)
Log(TNA _{t-1})		-0.1454*** (0.0314)		0.0155*** (0.0046)		-0.1608*** (0.0316)
Age _{t-1}		-0.1379 (0.0875)		-0.0751*** (0.0111)		-0.0628 (0.0862)
Turnover _{t-1}		-0.0172 (0.1406)		0.0193* (0.0102)		-0.0365 (0.1354)
Flow _{t-1}		-0.3011*** (0.0255)		-0.0796*** (0.0035)		-0.2215*** (0.0257)
Observations	36,681	35,108	36,681	35,108	36,681	35,108
R-squared	0.0191	0.0340	0.0942	0.1312	0.0204	0.0303

Fund Performance

- Performance of funds sorted according to their prior tax efficiency.
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 - Abnormal Performance Measures
 - Subperiods
 - Different Horizons
 - Distribution Types
 - Return Decomposition
 - DC Ratio
 - Fund Style
- Performance of self-designated tax-efficient funds.
 - Funds Matched by Family and Name
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Self-Designated Tax-Efficient Funds: Funds Matched by Family and Name

	Before-Tax Return _t	Tax Burden _t	After-Tax Return _t
Tax-Efficient Funds	0.2794 (0.7086)	0.5048*** (0.1080)	-0.2307 (0.7110)
Matched Funds	-0.0489 (0.9845)	2.1106*** (0.6640)	-2.1782* (1.1733)
Difference	0.3283 (0.5263)	-1.6059** (0.6688)	1.9475** (0.9201)

Self-Designated Tax-Efficient Funds: Funds Matched by Family and Investment Style

	Before-Tax Return _t	Tax Burden _t	After-Tax Return _t
Tax-Efficient Funds	-0.2875 (0.4676)	0.3052*** (0.0425)	-0.5927 (0.4587)
Matched Funds	-0.3148 (0.4564)	1.0842*** (0.1175)	-1.3990*** (0.4196)
Difference	0.0273 (0.2450)	-0.7790*** (0.1002)	0.8063*** (0.2576)

Self-Designated Tax-Efficient Funds: Funds Matched by Family, Investment Style, and Fund Size

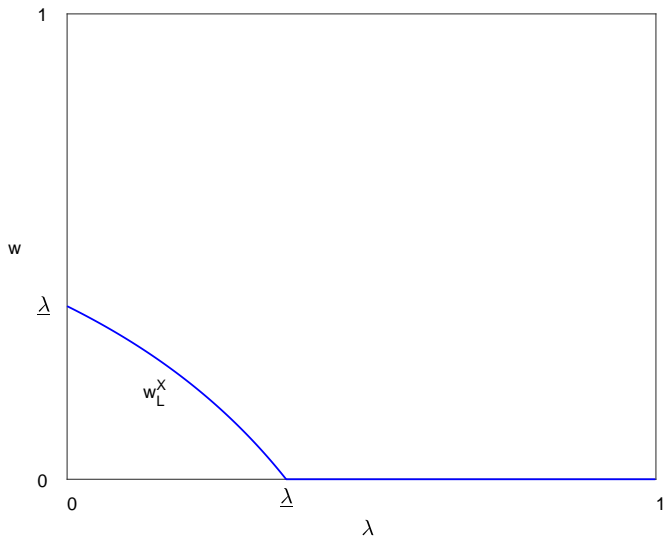
	Before-Tax Return _t	Tax Burden _t	After-Tax Return _t
Tax-Efficient Funds	-0.0010 (0.4749)	0.3228*** (0.0445)	-0.3238 (0.4687)
Matched Funds	-0.0597 (0.4367)	1.1106*** (0.1568)	-1.1703*** (0.4310)
Difference	0.0587 (0.2358)	-0.7877*** (0.1483)	0.8464*** (0.3095)

Conclusions

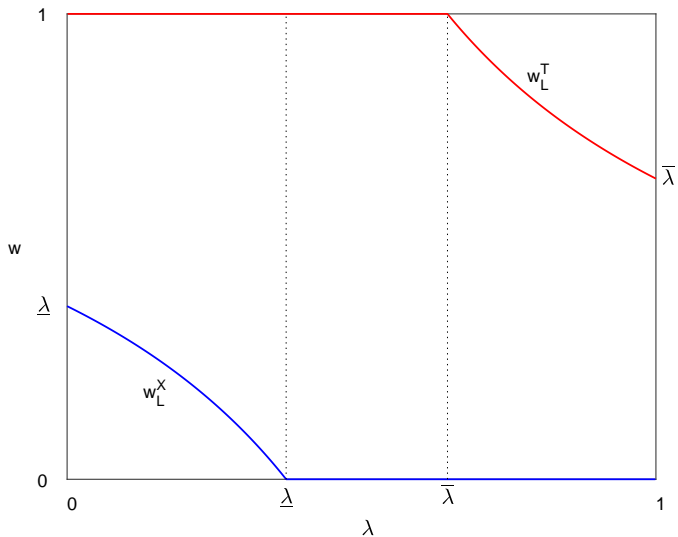
- Before-tax returns are not necessarily equalized in an environment with different tax clienteles.
- Tax-efficient funds exhibit both superior before- and after-tax performance.
- Tax-efficient funds exhibit lower trading costs, favorable style exposures, and superior investment ability.

Appendix

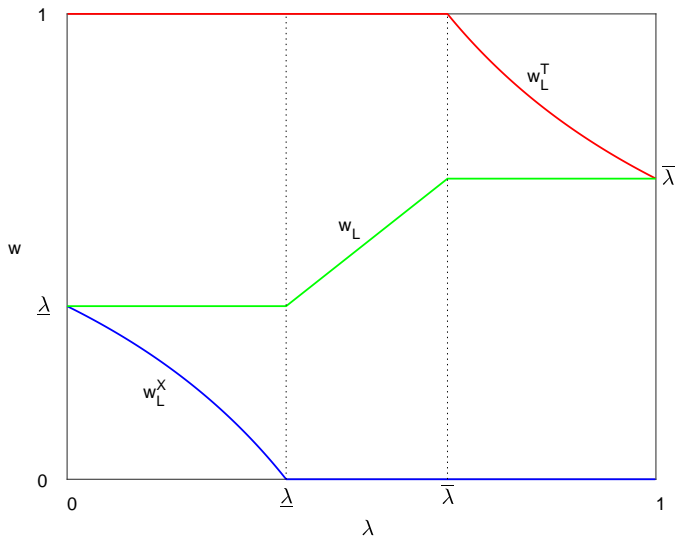
Allocations to Fund H



Allocations to Fund H



Allocations to Fund H



Model with Risk-Averse Agents

- Two investment strategies have returns that are jointly normally distributed. Mean returns are subject to decreasing returns to scale ($f' < 0$):

$$r_H \sim \mathcal{N}(f^H(w_H), \sigma_H^2)$$

$$r_L \sim \mathcal{N}(f^L(w_L), \sigma_L^2)$$

- Investors maximize CARA expected utility subject to short-selling constraints ($\omega_f^c \geq 0$):

$$U(W^c) = -\frac{1}{\gamma} \exp(-\gamma W^c)$$

$$W^c = \omega_L^c(1 + (1 - \tau_L^c)r_L) + (1 - \omega_L^c)(1 + (1 - \tau_H^c)r_H)$$

- Aggregate investment amounts to:

$$w_H = \lambda \omega_H^X + (1 - \lambda) \omega_H^T$$

$$w_L = \lambda \omega_L^X + (1 - \lambda) \omega_L^T$$

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Assumptions for Numerical Solution

- Decreasing returns to scale for investment strategies:

$$f^H(w_H) = \frac{2\mu}{(1 + w_H)}$$
$$f^L(w_L) = \frac{\mu}{2} + \frac{\mu}{(1 + w_L)}$$

- Numerical Assumptions:

$$\mu = 0.05$$

$$\sigma_H = 0.2$$

$$\sigma_L = 0.2$$

$$\rho = 0.5$$

$$\tau_H = 0.4$$

$$\tau_L = 0.2$$

$$\gamma = 1$$

$$\lambda = 0.5$$

Equilibrium using CARA-Normal

- The optimal portfolio weights for a tax-exempt and taxable investors are:

$$\omega_H^X = \max \left(0, \min \left(1, \frac{\mu_H - \mu_L + \gamma (\sigma_L^2 - \rho \sigma_H \sigma_L)}{\gamma (\sigma_H^2 + \sigma_L^2 - 2\rho \sigma_H \sigma_L)} \right) \right)$$

$$\omega_H^T = \max \left(0, \min \left(1, \frac{(1 - \tau_H)\mu_H - (1 - \tau_L)\mu_L + \gamma ((1 - \tau_L)^2 \sigma_L^2 - \rho(1 - \tau_H)(1 - \tau_L)\sigma_H \sigma_L)}{\gamma ((1 - \tau_H)^2 \sigma_H^2 + (1 - \tau_L)^2 \sigma_L^2 - 2\rho(1 - \tau_H)(1 - \tau_L)\sigma_H \sigma_L)} \right) \right)$$

- The aggregate portfolio weights in the two strategies are:

$$w_H = \lambda \omega_H^X + (1 - \lambda) \omega_H^T$$

$$w_L = \lambda (1 - \omega_H^X) + (1 - \lambda) (1 - \omega_H^T)$$

- The equilibrium is given by:

$$\mu_H = f^H(w_H)$$

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$$\omega_H^T = \max \left(0, \min \left(1, \frac{(1 - \tau_H)\mu_H - (1 - \tau_L)\mu_L + \gamma ((1 - \tau_L)^2 \sigma_L^2 - \rho(1 - \tau_H)(1 - \tau_L)\sigma_H \sigma_L)}{\gamma ((1 - \tau_H)^2 \sigma_H^2 + (1 - \tau_L)^2 \sigma_L^2 - 2\rho(1 - \tau_H)(1 - \tau_L)\sigma_H \sigma_L)} \right) \right)$$

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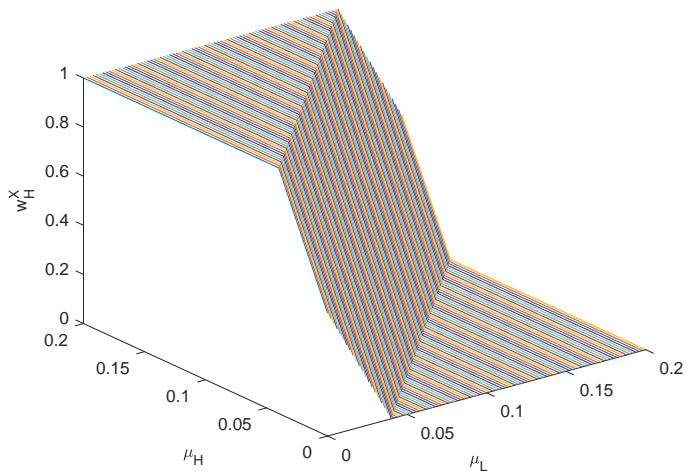
$$w_L = \lambda (1 - \omega_H^X) + (1 - \lambda) (1 - \omega_H^T)$$

- The equilibrium is given by:

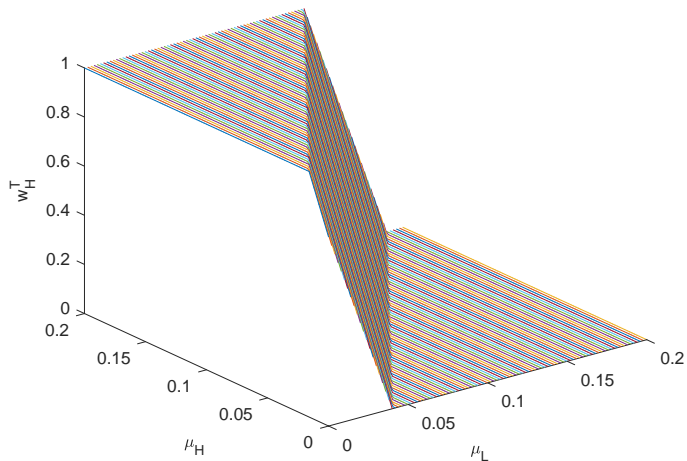
$$\mu_H = f^H(w_H)$$

$$\mu_L = f^L(w_L)$$

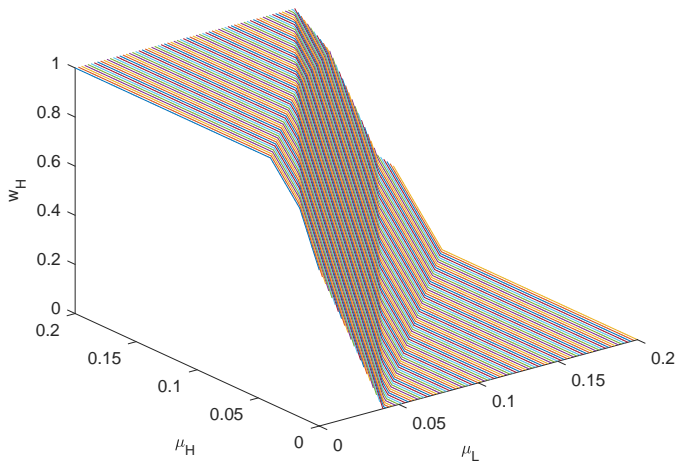
Demand for Fund H by Tax-Exempt Investors



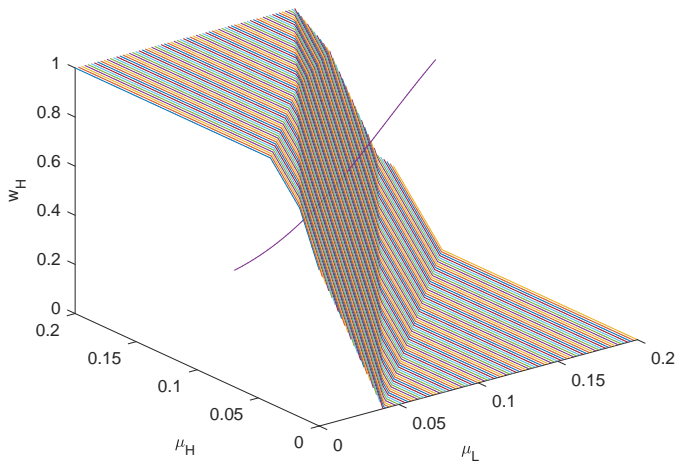
Demand for Fund H by Taxable Investors

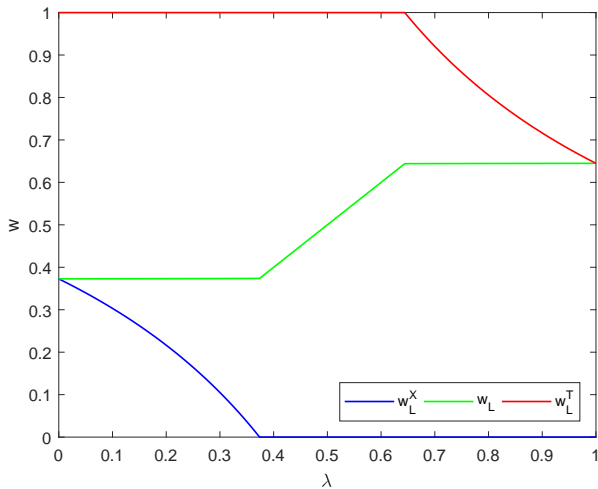


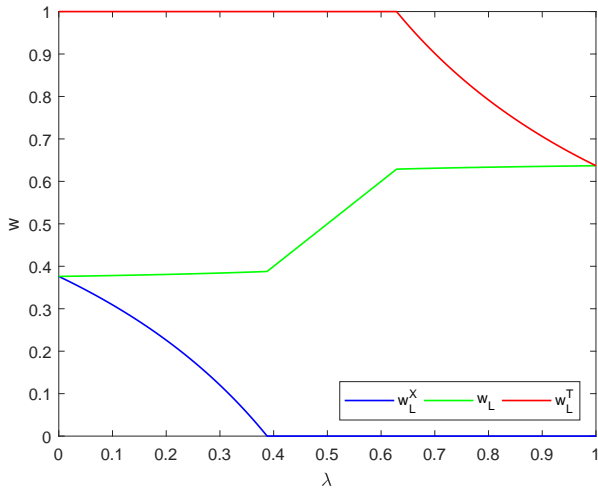
Aggregate Demand for Fund H

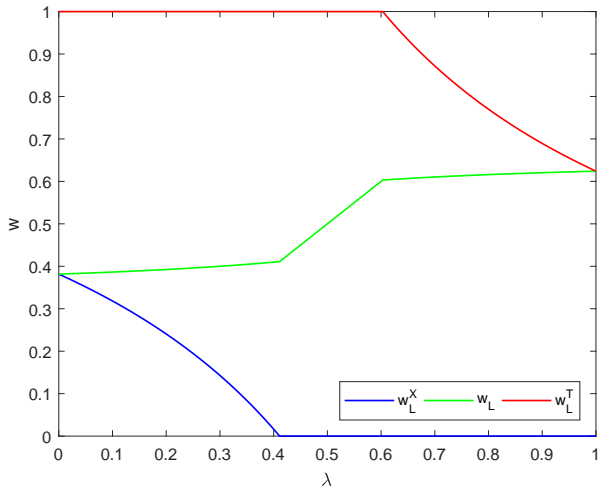


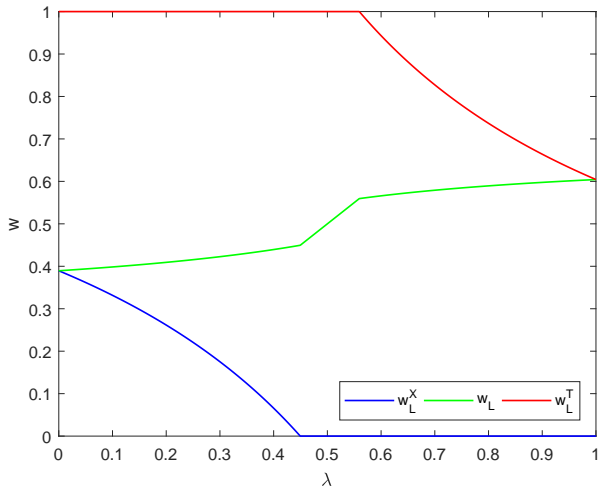
Equilibrium for Fund H



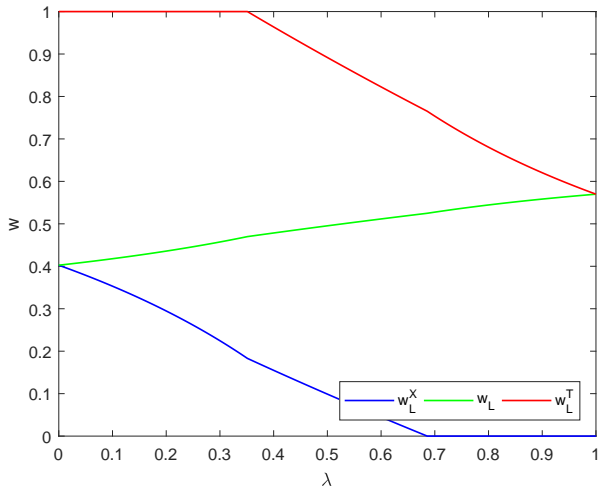
Portfolio Allocations ($\gamma = 0.01$)

Portfolio Allocations ($\gamma = 0.1$)

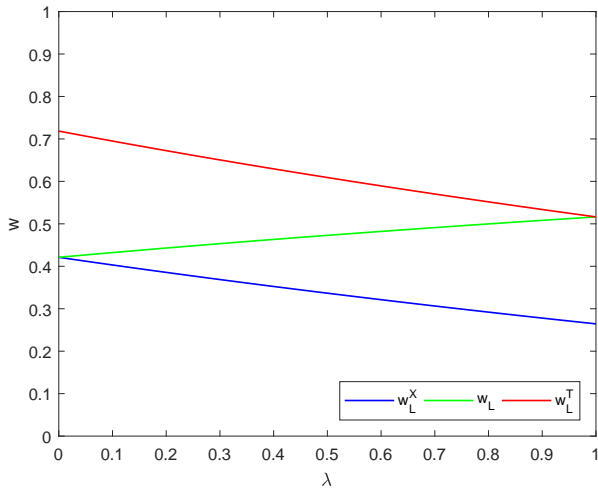
Portfolio Allocations ($\gamma = 0.25$)

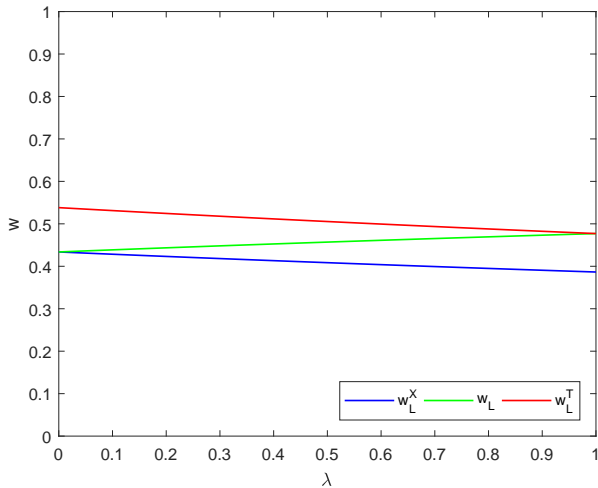
Portfolio Allocations ($\gamma = 0.5$)

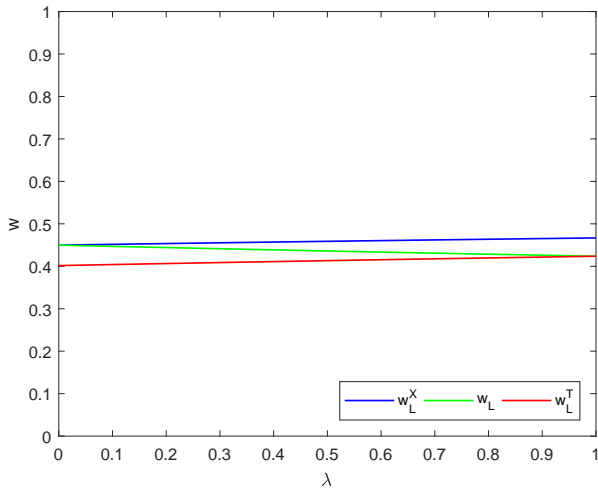
Portfolio Allocations ($\gamma = 1$)

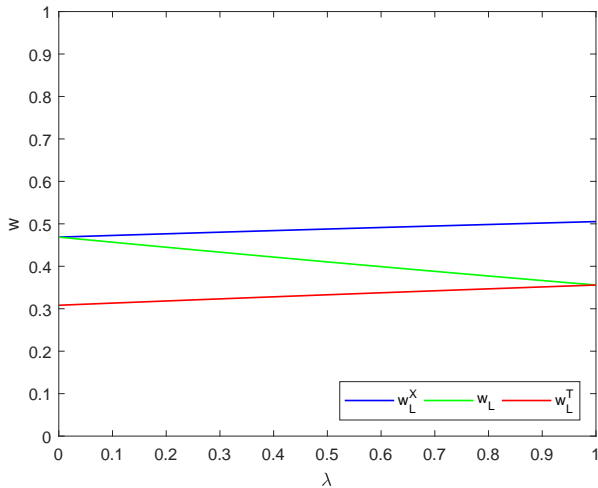


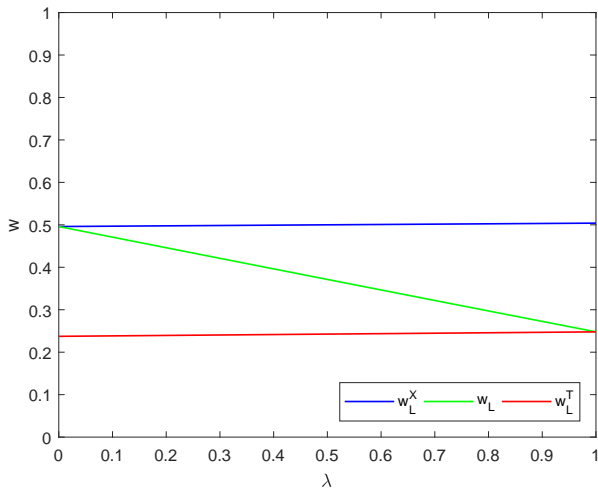
Portfolio Allocations ($\gamma = 2$)

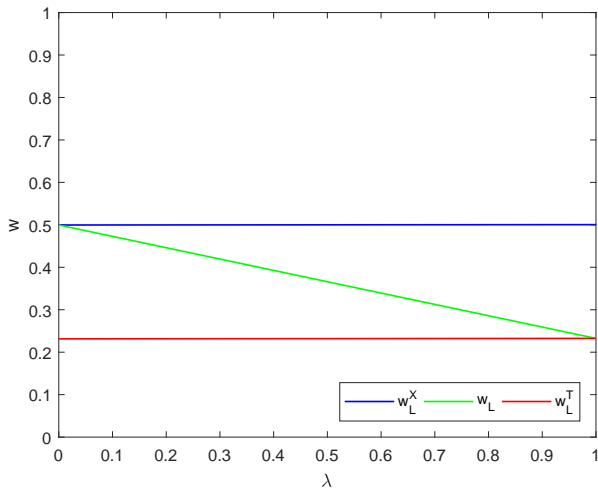


Portfolio Allocations ($\gamma = 3$)

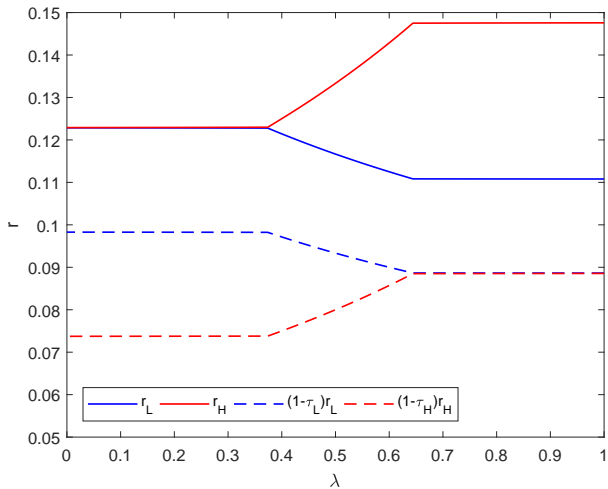
Portfolio Allocations ($\gamma = 5$)

Portfolio Allocations ($\gamma = 10$)

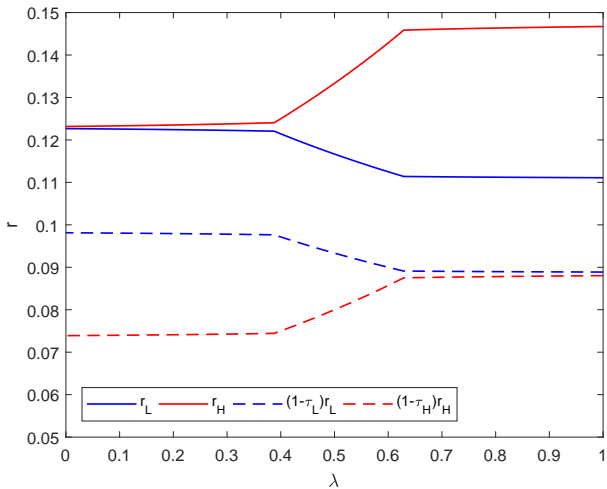
Portfolio Allocations ($\gamma = 100$)

Portfolio Allocations ($\gamma = 1000$)

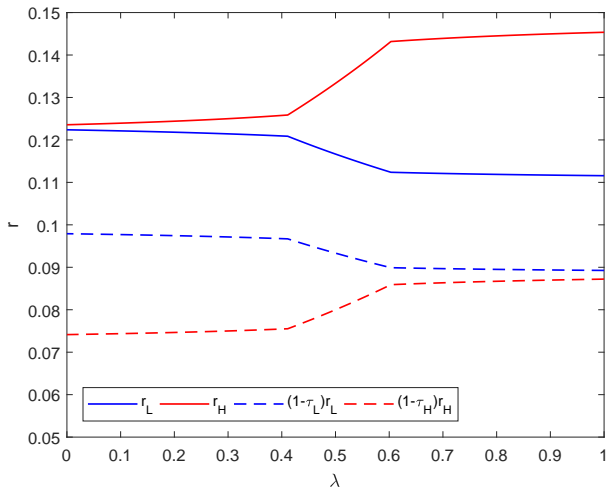
Fund Returns ($\gamma = 0.01$)



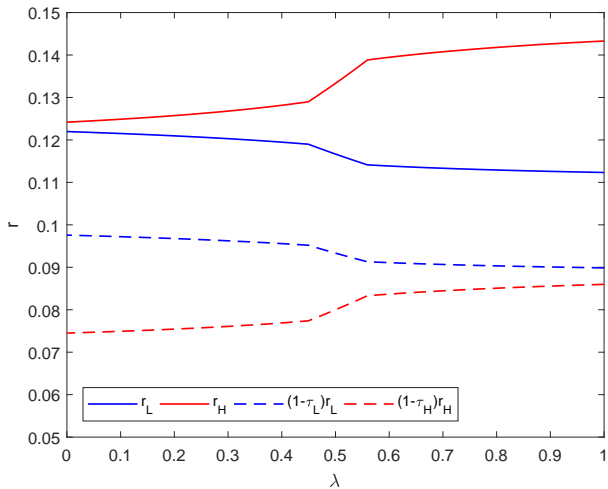
Fund Returns ($\gamma = 0.1$)



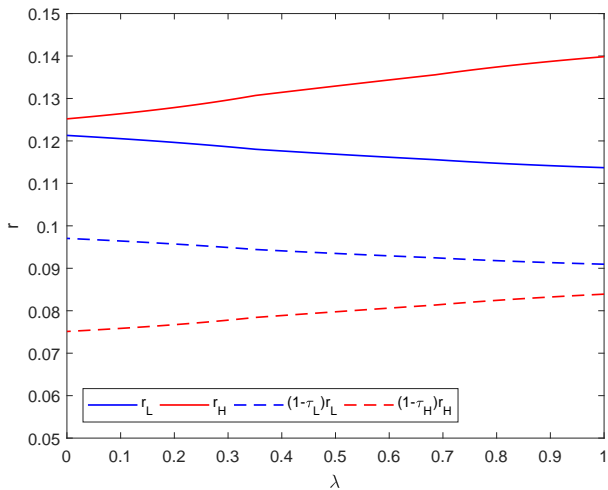
Fund Returns ($\gamma = 0.25$)

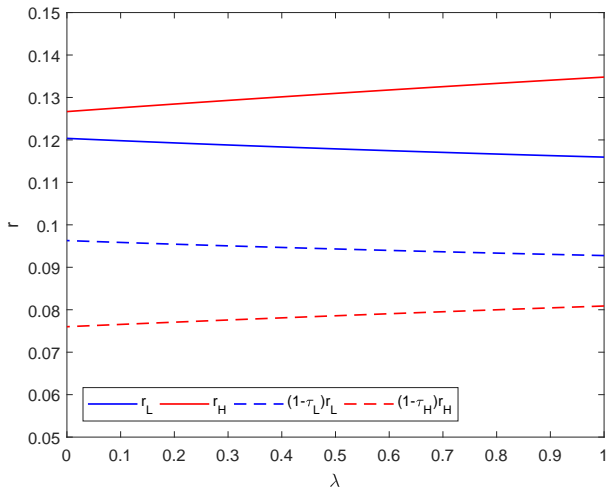


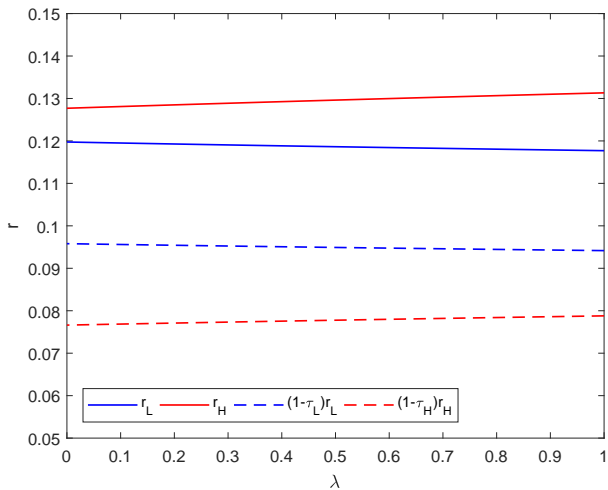
Fund Returns ($\gamma = 0.5$)

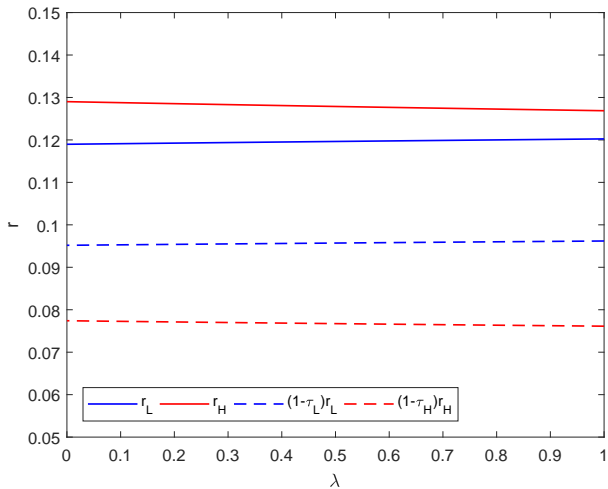


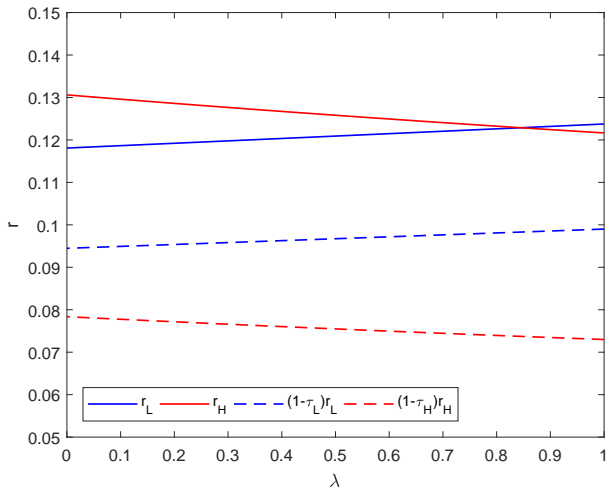
Fund Returns ($\gamma = 1$)



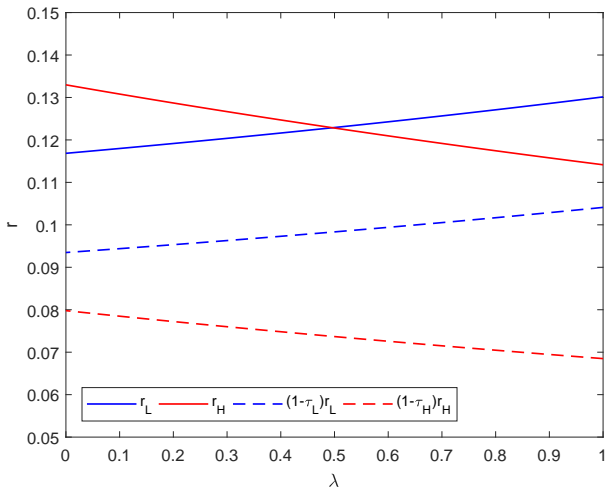
Fund Returns ($\gamma = 2$)

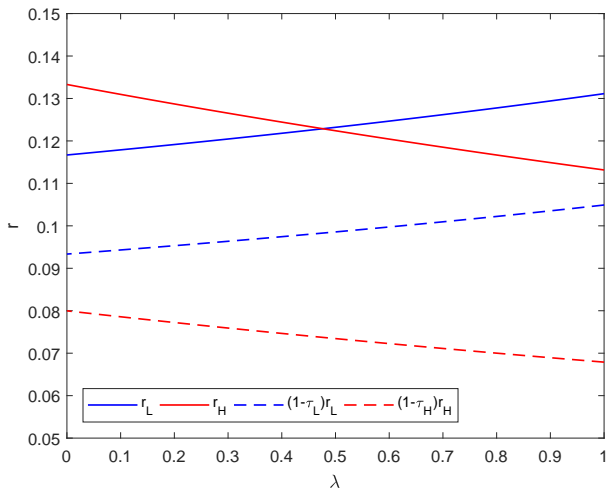
Fund Returns ($\gamma = 3$)

Fund Returns ($\gamma = 5$)

Fund Returns ($\gamma = 10$)

Fund Returns ($\gamma = 100$)

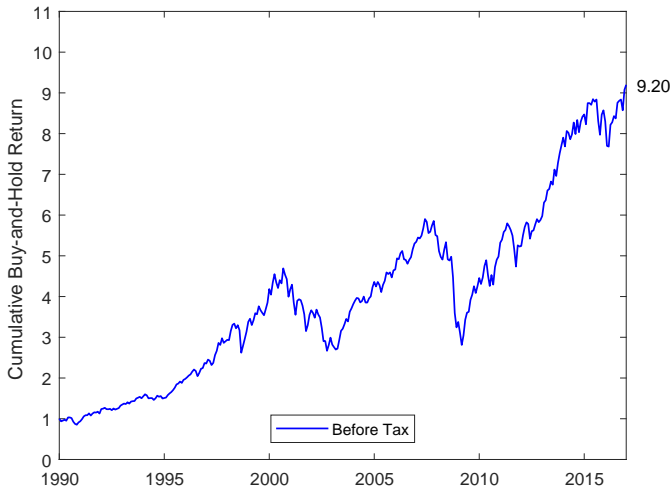


Fund Returns ($\gamma = 1000$)

Conclusions

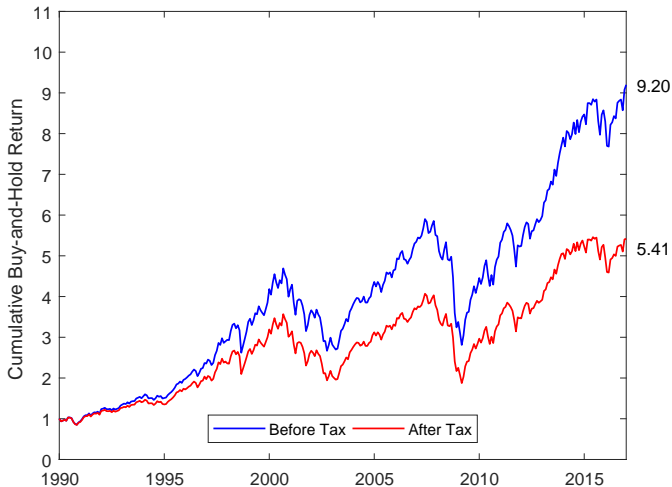
- Risk-Averse Investors:
 - The incentives to diversify across the two funds increases as risk aversion increases.
 - Sufficiently risk-averse taxable investors will hold relatively-high allocations of the highly-taxed asset because it exhibits lower risk levels.

Cumulative Returns for Highest Tax Burden Quintile



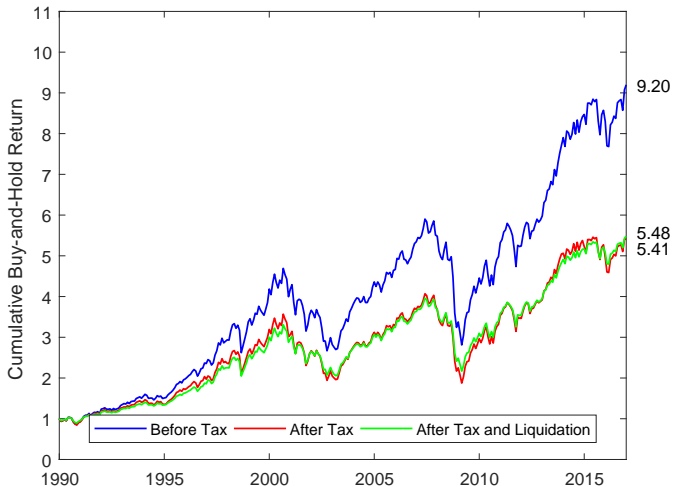
▶ Computation

Cumulative Returns for Highest Tax Burden Quintile



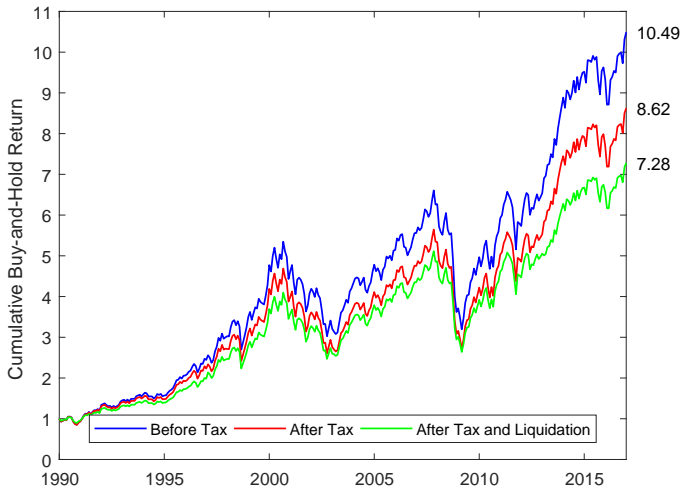
► Computation

Cumulative Returns for Highest Tax Burden Quintile



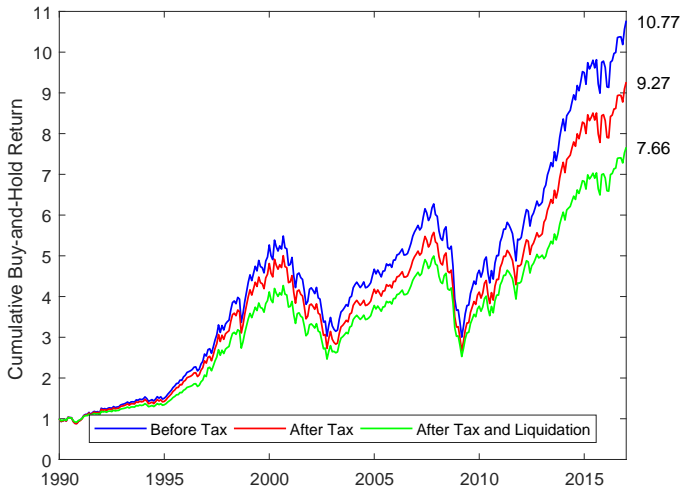
► Computation

Cumulative Returns for Lowest Tax Burden Quintile



► Computation

Cumulative Returns for Vanguard S&P 500 Index Fund



► Computation

Computation of Cumulative Returns

- Cumulative Buy-and-Hold Return Before Tax:

$$BHR_{f,t}^{BT} = BHR_{f,t-1}^{BT} (1 + R_{f,t}^{BT}), \text{ where } BHR_{f,1990}^{BT} = 1.$$

- Cumulative Buy-and-Hold Return After Tax:

$$BHR_{f,t}^{AT} = BHR_{f,t-1}^{AT} (1 + R_{f,t}^{AT}), \text{ where } BHR_{f,1990}^{AT} = 1.$$

- Cumulative Buy-and-Hold Return After Tax and After Liquidation:

$$\begin{aligned} BHR_{f,t}^{ATL} &= BHR_{f,t}^{AT} - \tau_t^{LCG} (BHR_{f,t}^{AT} - CB_{f,t}^{AT}), \\ CB_{f,t} &= CB_{f,t-1} + BHR_{f,t-1}^{AT} \\ &\quad \left((1 - \tau_t^{DIV}) Y_{f,t}^{DIV} + (1 - \tau_t^{SCG}) Y_{f,t}^{SCG} + (1 - \tau_t^{LCG}) Y_{f,t}^{LCG} \right), \\ &\text{ where } CB_{f,1990} = 1. \end{aligned}$$

Persistence of Tax Burden

Prior 1-Year Tax Burden Portfolio	Proportion	Tax Burden					
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Low	23.65	0.15	0.72	1.00	1.13	1.17	1.21
P2	19.09	0.56	0.98	1.13	1.25	1.22	1.25
P3	19.10	1.05	1.32	1.33	1.34	1.31	1.28
P4	19.10	1.64	1.60	1.50	1.40	1.35	1.31
High	19.06	3.18	2.12	1.82	1.67	1.51	1.37
High - Low		3.03	1.40*** (0.16)	0.82*** (0.11)	0.54*** (0.09)	0.33*** (0.10)	0.16* (0.09)

▶ Dividends

▶ ST CG

▶ LT CG

Persistence of Dividend Distributions

Prior 1-Year Dividend Portfolio	Proportion	Dividend Distributions					
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Low TB	32.88	0.02	0.12	0.13	0.15	0.18	0.18
P2	16.76	0.29	0.38	0.39	0.41	0.45	0.45
P3	16.79	0.79	0.79	0.78	0.75	0.73	0.71
P4	16.80	1.38	1.29	1.23	1.16	1.14	1.10
High TB	16.77	2.72	2.26	2.10	2.01	1.91	1.83
High - Low		2.71	2.15*** (0.11)	1.97*** (0.10)	1.85*** (0.10)	1.73*** (0.08)	1.65*** (0.08)

▶ Back

Persistence of Short-Term Capital Gains

Prior 1-Year STCG Portfolio	Proportion	Short-Term Capital Gains					
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Low TB	67.20	0.00	0.44	0.59	0.67	0.67	0.70
P2	8.17	0.16	0.58	0.73	0.62	0.65	0.63
P3	8.21	0.72	1.06	0.97	1.05	0.82	0.81
P4	8.23	1.79	1.63	1.39	1.24	1.18	1.01
High TB	8.19	5.62	2.90	2.33	1.97	1.61	1.43
High - Low		5.62	2.46*** (0.33)	1.74*** (0.27)	1.30*** (0.22)	0.94*** (0.19)	0.72*** (0.19)

▶ Back

Persistence of Long-Term Capital Gains

Prior 1-Year LTCG Portfolio	Proportion	Long-Term Capital Gains					
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Low TB	42.93	0.01	1.36	2.36	2.86	3.12	3.34
P2	14.24	0.84	2.73	3.29	3.60	3.68	3.72
P3	14.28	2.68	4.10	4.25	4.49	4.37	4.18
P4	14.30	5.08	5.25	5.07	4.88	4.77	4.47
High TB	14.25	11.01	6.99	6.06	5.71	5.09	4.64
High - Low		11.00	5.63***	3.70***	2.85***	1.97***	1.31***

▶ Back