Online Appendix to "Tax Uncertainty and Retirement Savings Diversification"

David C. Brown, Scott Cederburg, and Michael S. O'Doherty

November 14, 2016

A Effect of Asset Allocation on Retirement Savings Diversification

In this section, we investigate the sensitivity of our main results on the optimal location of retirement savings in traditional and Roth accounts to alternative asset allocation policies. In our base case, investors optimally choose an allocation between stocks and a risk-free asset. The resulting optimal weights on equity shown in Fig. 8 in the paper are relatively high compared to conventional advice, so we also examine retirement savers who use an age-based rule to determine the weight on stocks in their portfolios. We assume that our 10-year and 30-year investors are currently 55 and 35 years old, respectively, and we set their respective equity allocations to 40% and 50% to reflect common financial advice that investors decrease their allocations to stocks as they near retirement. The investors are then allowed to optimize over consumption and savings in traditional and Roth accounts. The analyses in Table OI.1 and Figs. OI.1 to OI.4 of this Appendix correspond to those from the base case in Table 3 and Figs. 4, 6, 7, and 9 in the paper.

The results suggest that the alternative asset allocation decision rule does not have a strong impact on the optimal usage of traditional and Roth accounts. Investors using the lower equity allocations outlined above tend to consume somewhat less and save more compared to our base case in an effort to bolster retirement consumption. The differences are relatively small, however, and the allocations and fees shown in Figs. OI.1 to OI.4 are nearly identical to the naked eye relative to our base case results. Table OI.1 shows that these investors tend to have lower retirement consumption compared to the results in Table 3 of the paper due to lower equity allocations. The main conclusions from the table, that investors are able to reduce their exposure to states with high tax rate realizations using Roth investments, continue to hold despite the change in the allocation to stocks.

B Supporting Evidence for Age-Based Investment Policies

In this section, we further investigate the rule proposed in Section 5.2 of the paper for investing across traditional and Roth accounts. Specifically, the rule dictates that investors allocate all of their savings to Roth accounts if their current taxable income corresponds to the lowest tax bracket and otherwise invest $(Age + 20)\%$ of their savings in traditional accounts with the remainder in Roth accounts. Fig. OI.5 shows fees that investors with horizons of 10, 20, 30, and 40 years would pay to fully optimize rather than use the $(Age + 20)\%$ rule. The first and third subfigures in Fig. OI.5 thus correspond to the top and bottom subfigures in Fig. 13 of the paper, respectively. The fees for 20-year and 40-year investors are relatively low and similar in magnitude to those paid by the 10-year and 30-year investors we consider in the paper. These results support the use of an age-based rule for investing across traditional and Roth accounts, since the $(Age + 20)\%$ rule works relatively well for investors with a wide range of retirement horizons.

We compare the performance of the $(Age + 20)\%$ rule to alternative age-based rules and constant proportion rules. Fig. OI.6 displays fees that 10-year investors would be willing to pay to fully optimize rather than adopt $(Age)\%$, $(Age+10)\%$, $(Age+20)\%$, and $(Age+30)\%$ rules. Investors thus invest 55%, 65%, 75%, and 85% of their retirement savings in traditional accounts across the four subfigures, with the remainder invested in Roth accounts. The third subfigure of Fig. OI.6 corresponds to the top subfigure of Fig. 13 in the paper. In general, investors with lower (higher) outside income in retirement pay relatively larger fees to avoid rules with lower (higher) allocations to traditional savings. The $(Age+10)\%$ and $(Age+20)\%$ rules provide the best balances across investor types. With the $(Age+10)\%$ rule, retirement savers with \$25,000 in future income have relatively high fees compared to the other investor types across large ranges of current income. These low-future-income investors have relatively low utilities compared to their higher-income counterparts, such that imposing large costs on this group may be undesirable. Switching from the $(Age+10)\%$ rule to the $(Age+20)\%$ rule reduces the maximum fee for these investors from 0.25% to 0.16% at a modest cost to other investors. Fig. OI.7 shows fees associated with the rules for 30-year investors. The third subfigure corresponds to the bottom subfigure of Fig. 13 in the paper. Fees are relatively low across investors and similar for the alternative rules. In particular, the maximum fees across all investors for the $(Age)\%$, $(Age + 10)\%$, $(Age + 20)\%$, and $(Age + 30)\%$ rules are 0.15%, 0.16%, 0.21%, and 0.30%, respectively. Table OI.2 shows the maximum fees for investors with current incomes between \$25,000 and \$250,000 with horizons of 10, 20, 30, and 40 years and future income levels of \$25,000, \$50,000, and \$75,000. Panel A reports fees for

the $(Age + 20)\%$ rule, such that these results correspond to the fees in Fig. OI.5. Panel B displays maximum fees for five rules under which all investors that are not currently in the lowest tax bracket invest the same proportion of their retirement savings in traditional accounts. The results indicate that 10-year investors with relatively low future incomes favor rules that place higher percentages of savings in traditional accounts, whereas longer-term investors prefer rules that place more savings in Roth accounts. The $(Age + 20)\%$ rule is designed to allow investors with different horizons to achieve allocations that are closer to their optimal strategies compared to the constant proportion rules. Overall, we propose the $(Age + 20)\%$ rule in Section 5.2 of the paper because it provides a desirable balance in performance across investor types.

Table OI.1: Distributional Statistics: Future Tax Rates and Retirement Consumption

The table reports average future tax rates and retirement consumption statistics in thousands of dollars for an example investor with current income of $130,000 and retirement income of $50,000 in 30 years. Rather than fully optimizing over asset allocation, the investor allocates 50% of his portfolio to stocks. The second column reports unconditional averages. The following five columns report averages conditional on realizations of the highest tax rate (i.e., $\tilde{\tau}_{H,T}$). Panel A reports the frequency of realizations and average tax rates for each of the tax brackets. Panel B presents retirement consumption values resulting from ignoring tax uncertainty in forming consumption and investment decisions. The three rows of values show the 10th, 50th, and 90th percentiles of retirement consumption realizations. Panel C reports results from considering tax uncertainty in those decisions, also showing the 10th, 50th, and 90th percentiles of retirement consumption realizations.

		Realization of $\tilde{\tau}_{H,T}$				
	Unconditional	0-20%	20-40%	40-60%	60-80%	80-100%
Panel A: Future Marginal Tax Rates						
Frequency	100.0%	22.6%	38.4%	28.3%	9.0%	1.7%
Average $\tilde{\tau}_{L,T}$	14.6%	4.8%	12.7%	19.7%	27.3%	36.5%
Average $\tilde{\tau}_{M,T}$	24.8%	7.9%	21.9%	33.7%	45.1%	57.7%
Average $\tilde{\tau}_{H,T}$	35.4%	10.8%	30.3%	48.6%	67.5%	88.1%
Panel B: Retirement Consumption of Investor Who Ignores Tax Uncertainty						
10th Percentile	75.0	93.1	81.8	71.8	61.2	44.9
50th Percentile	132.7	169.7	142.4	117.2	91.6	63.1
90th Percentile	342.2	447.0	359.1	277.4	194.3	106.8
Panel C: Retirement Consumption of Investor Who Considers Tax Uncertainty						
10th Percentile	78.8	87.9	81.0	75.0	68.8	61.6
50th Percentile	142.5	157.5	145.8	135.1	124.7	113.3
90th Percentile	360.7	405.5	368.6	334.5	300.7	264.8

Table OI.2: Maximum Annual Fees for the $(Age + 20)\%$ Rule and Constant Proportion Rules

The table reports the maximum annual percentage fees that unconstrained investors would be willing to pay on their savings in exchange for being allowed to fully optimize rather than use the $(Age + 20)\%$ rule (Panel A) or constant proportion rules (Panel B). Specifically, the $(Age + 20)\%$ rule dictates that investors allocate all of their savings to Roth accounts if their current taxable income corresponds to the lowest tax bracket and otherwise invest $(Age + 20)\%$ of their savings in traditional accounts with the remainder in Roth accounts. The constant proportion rules maintain a constant allocation across traditional and Roth accounts regardless of age for investors who do not qualify for the lowest tax bracket. For each investor type, we report the maximum fee across investors with \$25,000 to \$250,000 in current income who save at least 2% of their current income. To calculate these fees, we begin with investors who follow a retirement savings rule and measure their expected utility. We then allow the investors to reoptimize using any desired allocation across traditional and Roth accounts, but we place an annual fee on their savings. We find the fee that makes the investors indifferent between reoptimizing and keeping their original strategy.

	10-Year Horizon			20-Year Horizon			30-Year Horizon			40-Year Horizon		
	Future Income			Future Income			Future Income			Future Income		
	\$25,000	\$50,000	\$75,000	\$25,000	\$50,000	\$75,000	\$25,000	\$50,000	\$75,000	\$25,000	\$50,000	\$75,000
Panel A: Maximum Fees for $(Age + 20)\%$ Rule												
$(Age + 20)\%$	0.16%	0.21%	0.31%	0.06%	0.18%	0.27%	0.06%	0.14%	0.21%	0.05%	0.11%	0.17%
Panel B: Maximum Fees for Constant Proportion Rules												
40% Traditional	0.57%	0.32%	0.16%	0.23%	0.09%	0.14%	0.13%	0.10%	0.14%	0.07%	0.10%	0.14%
50% Traditional	0.40%	0.24%	0.18%	0.15%	0.12%	0.18%	0.07%	0.13%	0.18%	0.04%	0.13%	0.19%
60% Traditional	0.30%	0.16%	0.22%	0.09%	0.16%	0.23%	0.04%	0.17%	0.25%	0.01%	0.18%	0.27%
70% Traditional	0.21%	0.19%	0.27%	0.04%	0.20%	0.32%	0.04%	0.21%	0.35%	0.05%	0.22%	0.37%
80% Traditional	0.12%	0.23%	0.36%	0.06%	0.25%	0.43%	0.11%	0.29%	0.48%	0.13%	0.32%	0.53%

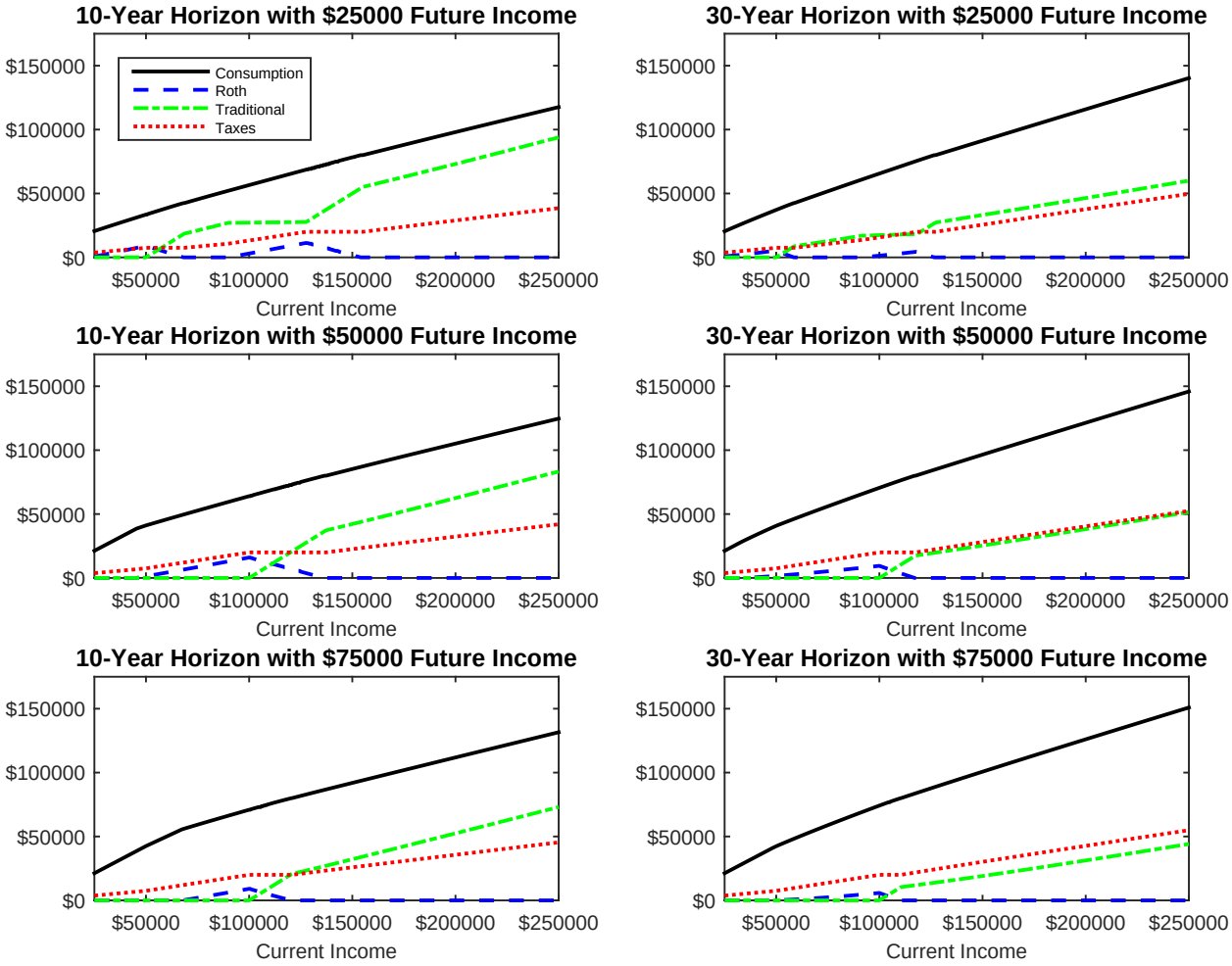

Fig. OI.1: Optimal consumption and savings with no uncertainty about future tax rates. This figure shows investors' optimal policy choices when future tax rates are known. Rather than fully optimizing over asset allocation, the 10-year (30-year) investors allocate 40% (50%) of their portfolio to stocks. Each subfigure plots current consumption, savings into Roth and traditional retirement accounts, and the resulting current tax liability as functions of current income. The first (second) column of subfigures shows policies corresponding to a 10-year (30-year) retirement horizon. The rows of subfigures present results for investors with $25,000, $50,000, or $75,000 of guaranteed retirement income.

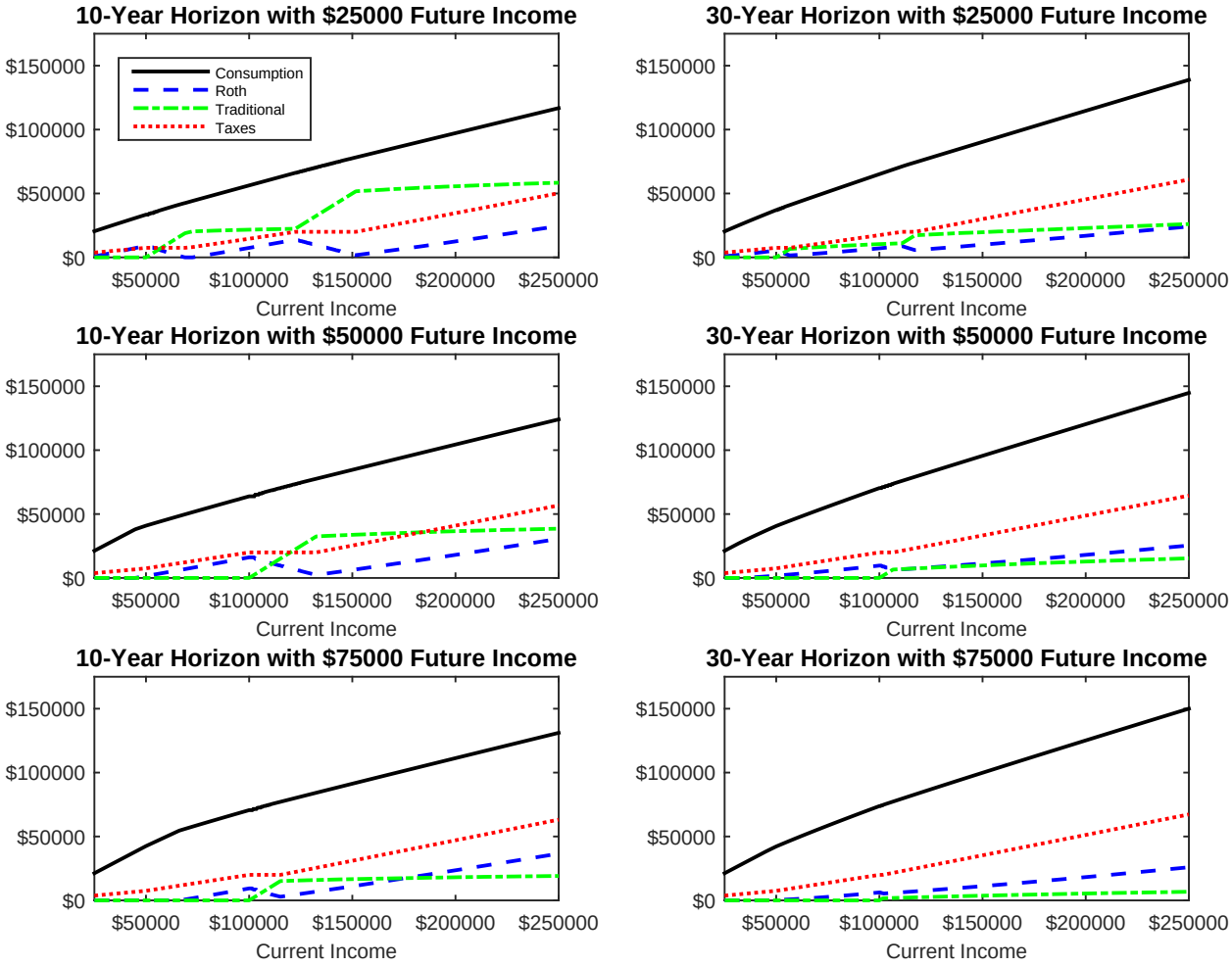

Fig. OI.2: Optimal consumption and savings with uncertainty about future tax rates. This figure shows investors' optimal policy choices when future tax rates are unknown. Rather than fully optimizing over asset allocation, the 10-year (30-year) investors allocate 40% (50%) of their portfolio to stocks. Each subfigure plots current consumption, savings into Roth and traditional retirement accounts, and the resulting current tax liability as functions of current income. The first (second) column of subfigures shows policies corresponding to a 10-year (30-year) retirement horizon. The rows of subfigures present results for investors with $25,000, $50,000, or $75,000 of guaranteed retirement income.

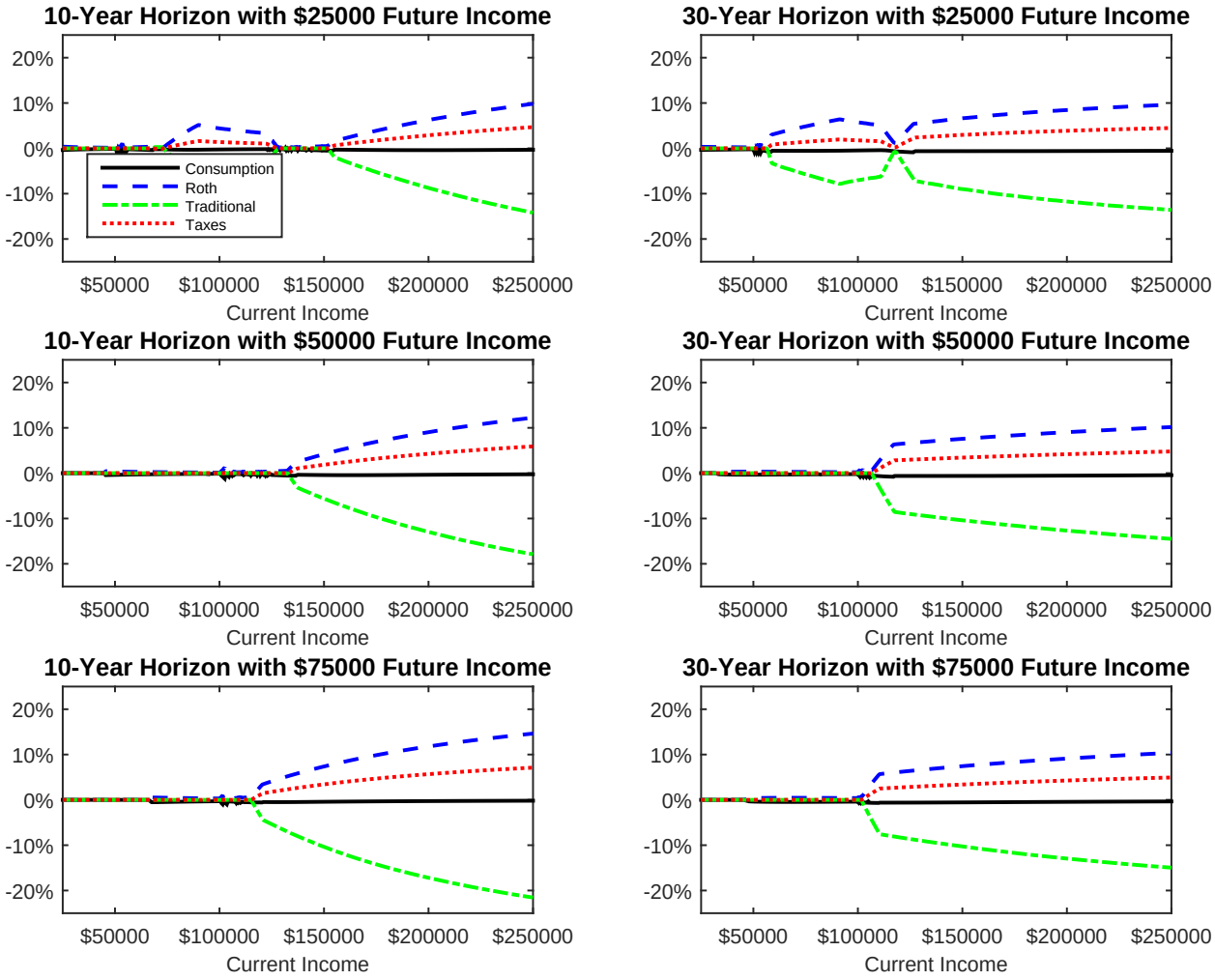

Fig. OI.3: Differences in policies for investors with and without tax uncertainty. This figure shows the differences in investors' optimal policy choices between the cases in which future tax rates are unknown and known. Specifically, the reported quantities are the differences between the policies in Fig. OI.2 and Fig. OI.1 as percentages of current income. Rather than fully optimizing over asset allocation, the 10-year (30-year) investors allocate 40% (50%) of their portfolio to stocks. Each subfigure plots the percentage differences for current consumption, savings into Roth and traditional retirement accounts, and the resulting current tax liability as functions of current income. The first (second) column of subfigures shows policy differences corresponding to a 10-year (30-year) retirement horizon. The rows of subfigures present results for investors with $25,000, $50,000, or $75,000 of guaranteed retirement income.

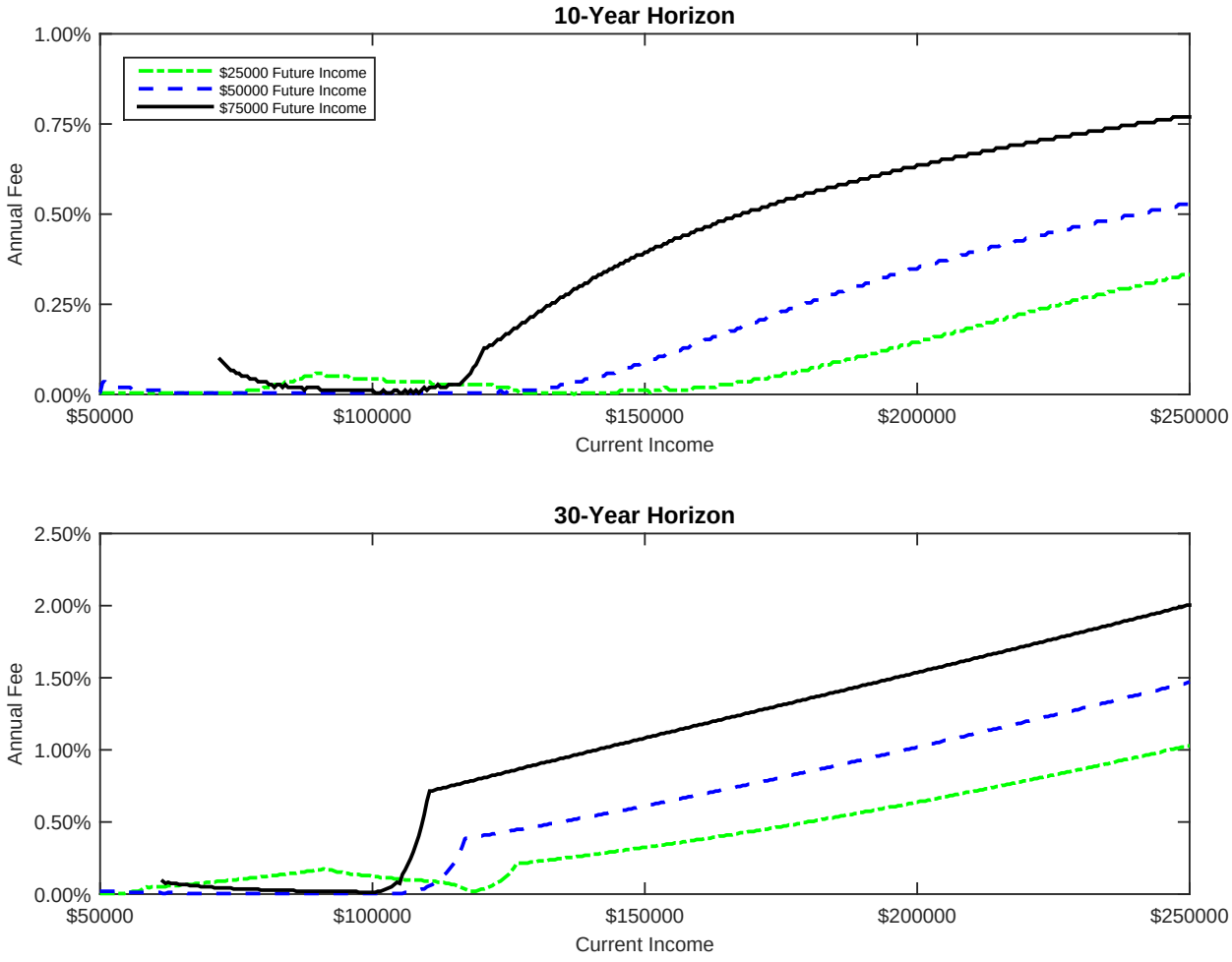

Fig. OI.4: Annual fees that investors are willing to pay to form policies that consider tax uncertainty. This figure shows the annual percentage fees that investors would be willing to pay on their savings in exchange for being allowed to consider tax-schedule uncertainty while making allocations. To calculate these fees, we begin with the investors in Fig. OI.1 who form their optimal policies under known, progressive tax rates. We then expose these investors to uncertainty about the future tax schedule and measure their expected utility. Finally, the investors are allowed to reoptimize considering all sources of uncertainty, but we place an annual fee on their savings. We find the fee that makes the investors indifferent between reoptimizing and keeping their original strategy. Rather than fully optimizing over asset allocation, the 10-year (30-year) investors allocate 40% (50%) of their portfolio to stocks. Each subfigure plots fees as functions of current income, and the three lines in each subfigure show fees for investors with \$25,000, \$50,000, or \$75,000 of guaranteed retirement income. The top (bottom) subfigure presents results corresponding to a 10-year (30-year) retirement horizon. We report fees for investors who save at least 2% of their current income.

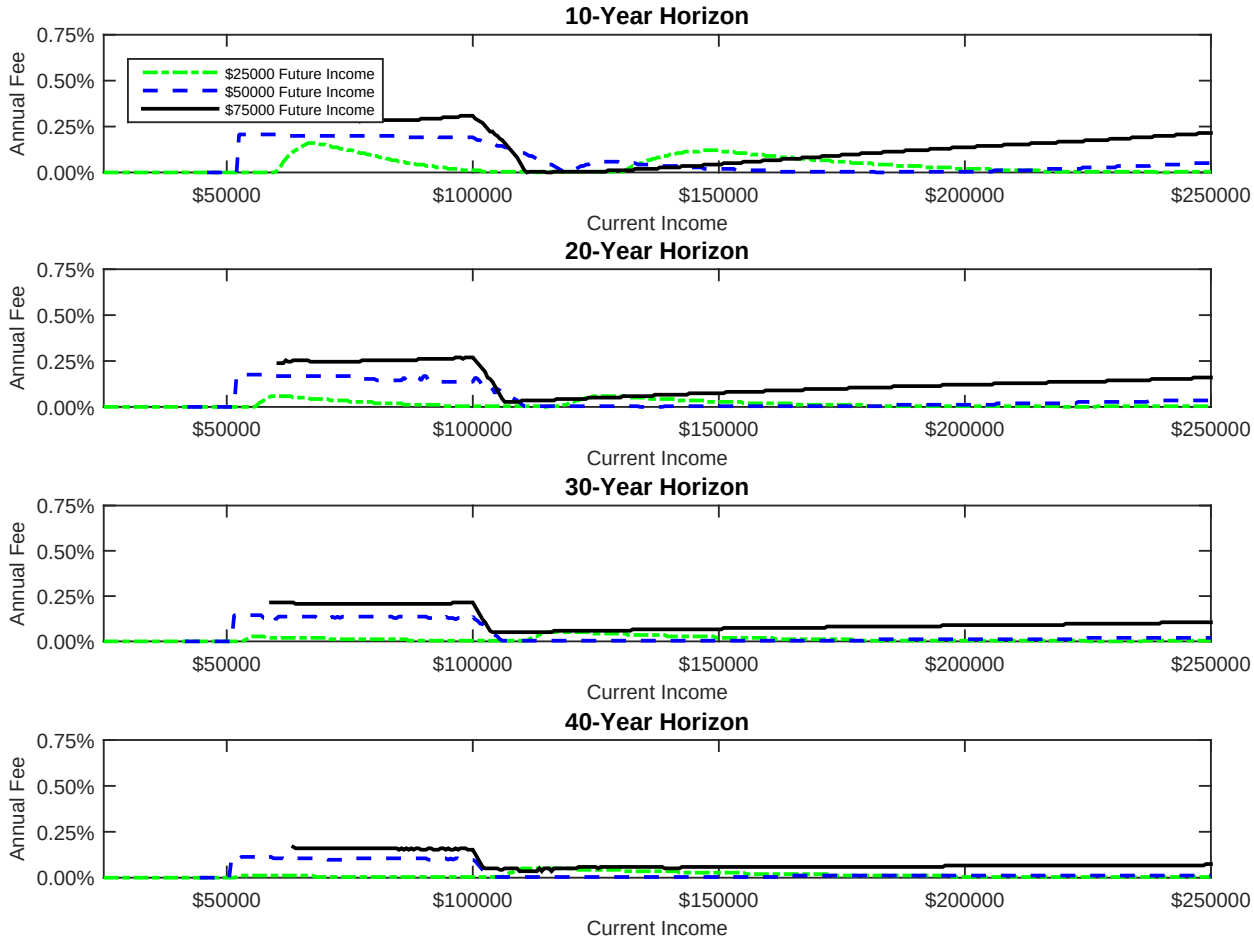

Fig. OI.5: Annual fees that investors are willing to pay to optimize rather than follow the $(Age + 20)\%$ rule. This figure shows the annual percentage fees that investors would be willing to pay on their savings in exchange for being allowed to fully optimize rather than use the rule proposed in Section 5.2. Specifically, the rule dictates that investors allocate all of their savings to Roth accounts if their current taxable income corresponds to the lowest tax bracket and otherwise invest $(Age + 20)\%$ of their savings in traditional accounts with the remainder in Roth accounts. To calculate these fees, we begin with investors who follow this retirement savings rule and measure their expected utility. We then allow the investors to reoptimize using any desired allocation across traditional and Roth accounts, but we place an annual fee on their savings. We find the fee that makes the investors indifferent between reoptimizing and keeping their original strategy. Each subfigure plots fees as functions of current income, and the three lines in each subfigure show fees for investors with \$25,000, \$50,000, or \$75,000 of guaranteed retirement income. The four subfigures present results corresponding to 10-year, 20-year, 30-year, and 40-year retirement horizons. We report fees for investors who save at least 2% of their current income.

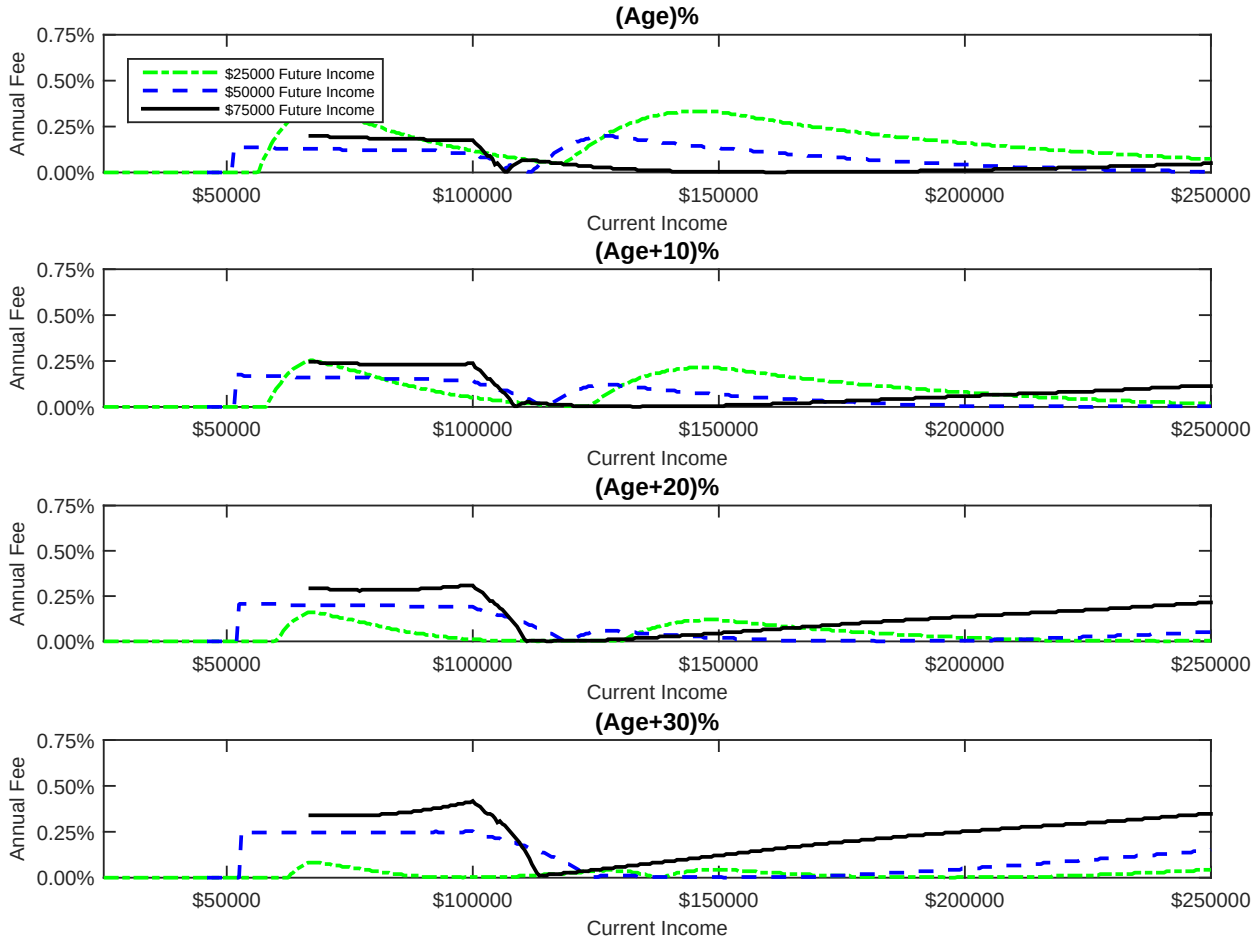

Fig. OI.6: Annual fees that 10-year investors are willing to pay to optimize rather than follow age-based rules. This figure shows the annual percentage fees that 10-year investors would be willing to pay on their savings in exchange for being allowed to fully optimize rather than use age-based rules for investing across traditional and Roth accounts. Specifically, we consider four rules that dictate that investors allocate all of their savings to Roth accounts if their current taxable income corresponds to the lowest tax bracket and otherwise invest $(Age)\%$, $(Age + 10)\%$, $(Age + 20)\%$, or $(Age + 30)\%$ of their savings in traditional accounts with the remainder in Roth accounts. To calculate these fees, we begin with investors who follow one of the four retirement savings rules and measure their expected utility. We then allow the investors to reoptimize using any desired allocation across traditional and Roth accounts, but we place an annual fee on their savings. We find the fee that makes the investors indifferent between reoptimizing and keeping their original strategy. Each subfigure plots fees as functions of current income, and the three lines in each subfigure show fees for investors with \$25,000, \$50,000, or \$75,000 of guaranteed retirement income. We report fees for investors who save at least 2% of their current income.

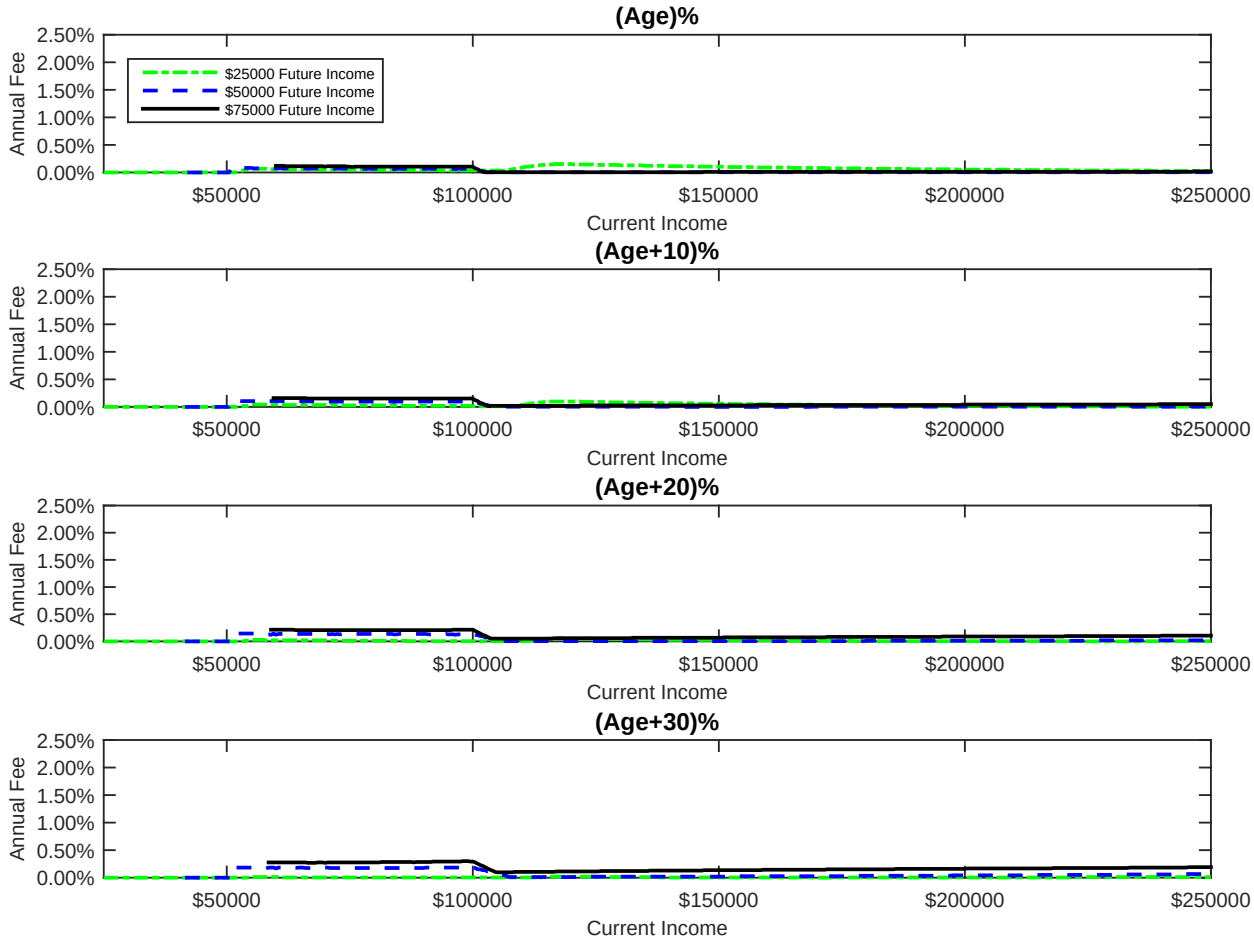

Fig. OI.7: Annual fees that 30-year investors are willing to pay to optimize rather than follow age-based rules. This figure shows the annual percentage fees that 30-year investors would be willing to pay on their savings in exchange for being allowed to fully optimize rather than use age-based rules for investing across traditional and Roth accounts. Specifically, we consider four rules that dictate that investors allocate all of their savings to Roth accounts if their current taxable income corresponds to the lowest tax bracket and otherwise invest $(Age)\%$, $(Age + 10)\%$, $(Age + 20)\%$, or $(Age + 30)\%$ of their savings in traditional accounts with the remainder in Roth accounts. To calculate these fees, we begin with investors who follow one of the four retirement savings rules and measure their expected utility. We then allow the investors to reoptimize using any desired allocation across traditional and Roth accounts, but we place an annual fee on their savings. We find the fee that makes the investors indifferent between reoptimizing and keeping their original strategy. Each subfigure plots fees as functions of current income, and the three lines in each subfigure show fees for investors with \$25,000, \$50,000, or \$75,000 of guaranteed retirement income. We report fees for investors who save at least 2% of their current income.