

Using Option Theory to Determine Optimal IRA Investment

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Given the current uncertain economic trends, the decision to contribute to a personal retirement account can be a financial challenge taking a great deal of courage. Using the option theory, this paper presents arguments to justify the optimal contribution to maximize an IRA investment return.

INTRODUCTION

For those in the workforce during the past decade who experienced a stock market downturn and financial collapse, retirement planning might sound like a crazy idea. But despite the shaky financial introduction, young adults (the millennial generation - individuals born between 1982 and 2000) have a lot going for them with a host of alternatives including early investment, thinking long-term, taking advantage of tax-advantages and engaging in company matching plans.

Older adults and baby boomers approaching retirement are looking for ways to maintain and perhaps enhance their retirement assets. During the same time, they must consider many financial decisions and obligations. Obligations include debt such as a mortgage, credit cards, auto loans, education loans, etc. Financial decisions include buying insurance, saving for a home purchase versus renting, or contributing to a savings account to meet emergency needs. Adding to these challenges, more than three-quarters of adults in their 50s experience layoffs, widowhood, divorce, new health problems or the onset of frailty of parents or in-laws, all of which disrupt their ability to save (Cembalest, Woods & Roy, 2015). Said another way, financial planning is important and it only gets tougher as you age.

The most common postretirement (retirement) plan employers offer employees is a 401(K) plan. However, another financial option is an individual retirement account (IRA). The benefit of the 401(K) and IRA is the tax advantages of these accounts and the improvement of the after-tax rate of return (Geisler & Stern, 2014) because contributions to these accounts are made with before tax dollars. That is, the contributions and earnings are not taxed until withdrawn. This paper illustrates the amount one should invest in an IRA by presenting an optimization of the IRA contribution to maximize the investment return using option theory.

Only about half of adults between ages 25 to 58 own a retirement account, and most of these accounts are employer-based 401(k)s instead of IRAs, it is becoming more important for people to consider IRAs

(Butrica, Zedlewski & Issa, 2010). One-third of adults in their 50s, considering when they will retire, are realizing that they have no retirement plan in place at all (Lusardi, 2003). This could be because they think that they will have enough money saved to be able to support them, but, in reality, 57 percent of retirees claim that they rely on Social Security for their retirement funding (Jacobe, 2012). This is in contrast to the 33 percent of non-retired people who expect to rely on Social Security. Officials have begun to implement policies in attempts to increase people's retirement savings (Madrian & Shea, 2001). They are doing this by requiring employers who have more than 10 workers to automatically set up IRAs for their employees, which the employee can opt out if they choose (Madrian & Shea, 2001). These data have not improved over time.

In 2014, approximately one-third of U.S. households owned IRAs. Of this group, 80 percent also had employer-sponsored retirement plan accumulations or a defined benefit plan. In total, 63% of all U.S. households had a retirement plan through work or an IRA (Holden & Schrass, 2015). Apparently rollovers from employer-sponsored retirement plans fueled the IRA growth. Some 81 percent of U.S. households indicated they rolled over the entire retirement amount into their IRA in addition to making contributions to their traditional IRAs (Holden & Schrass, 2015)

In early 2015, the traditional way of financial advisors giving retirement advice changed (Zweig, 2015). The U.S. Department of Labor moved ahead with rules that require investment advisors to provide advice on retirement plans and IRAs in the best interest of the account's holder. This action results in the biggest change since stock deregulation in the 1970s. At risk are more than \$14 trillion in IRAs and 401(K)- type retirement plans. The Labor Department (2015) proposed rules indicate that anyone providing investment advice must behave as a fiduciary for the investor/client so as to avoid any conflict of interest. As a fiduciary, the advisor must act in the best interest of the investor meaning they must be prudent, not misleading or taking advantage of the investor by minimizing and disclosing any conflict of interest (Zweig, 2015; DOL, 2015).

The DOL proposal will tend to reduce the incentive of advisors to recommend rollovers when boomers leave the workforce thus reduce the advisor's fees or commissions on retirement funds shifted to IRAs (Tergesen & Prior, 2016). Due to the increase in 401(k) and an increasing mobile workforce, rollovers in 2016 are expected to amount to \$439 billion up from \$271 billion in 2010 (Tergesen & Prior, 2016).

Many studies look at the decision that individuals make when determining whether or not to implement a plan to start an IRA. An important aspect to consider is the breakeven time horizon, also called the breakeven holding period, which shows the amount of time it will take for the tax advantages of having the funds invested in a retirement account to outweigh the 10 percent penalty which is charged if funds need to be withdrawn early (Horan, 2004). If a person finds that their breakeven time horizon will be fairly short, they should invest in a tax-advantage IRA, even if they invest knowing that they will need to make early withdrawals (Horan, 2004). A saver must also consider the flexibility of their choices, in case they need to change their decisions based on changing conditions (Trigeorgis, 1993). Maybe people do not save because they feel they will need the money sometime in the near future because of possible volatility of their income. Based on multiple constraints, this paper determines the level of volatility that could be present to invest in IRAs.

THEORY

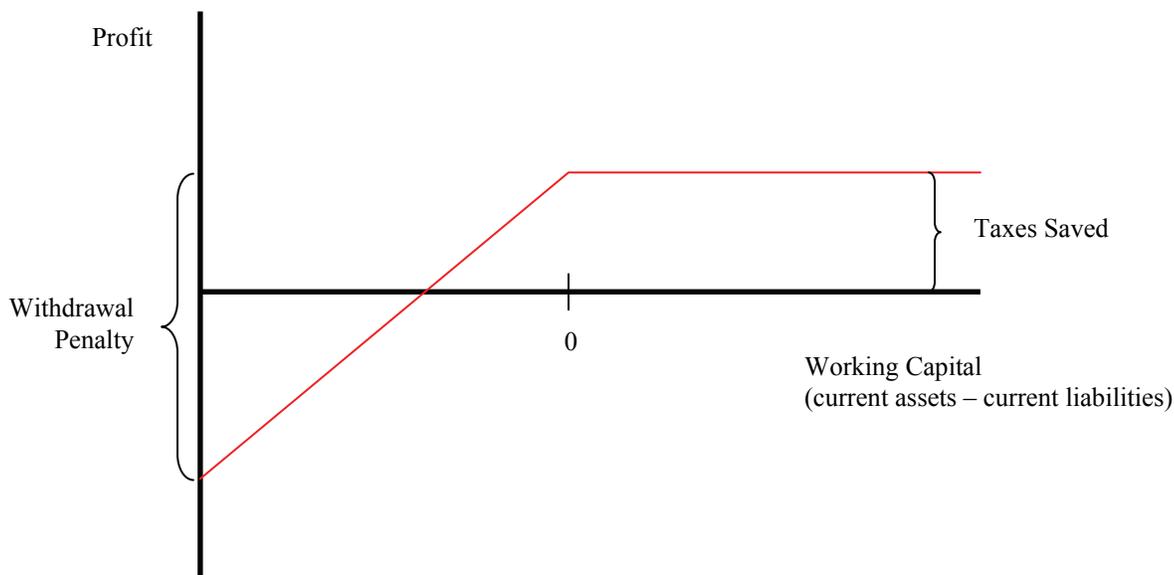
Prior research attempts to argue that the decision to invest in an IRA is the length of time an individual can hold out before they might incur the withdrawal penalty. We illustrate that the decision to invest in an IRA should be determined by the volatility of an individual's working capital. Using option theory, we determine the ideal amount to invest in an IRA.

The main variable in the volatility of an individual's working capital is typically their income or salary. However, individuals may face high volatility in their expenses depending on their lifestyle. In either case, volatility in an individual's working capital should be the main determinant in deciding to invest in an IRA.

Investing in an IRA provides investors with a tax advantaged way of saving for retirement. The amount of money invested can be used as a tax deduction on taxes in the year the investment is made. However, if an individual is forced to withdraw their money from the IRA prior to the mandated time (59.5) then they incur a 10% penalty from the IRS.

This structure is similar to that of an American style option, specifically a short put. The parameters of the option would be a time horizon (59.5 - current age) and strike price of the need for cash (working capital < 0). The premium received from this short put would be equal to the taxes saved through the tax deduction and the amount paid out in the event of the exercise of the option would be equal to the 10% withdrawal penalty. Figure 1 displays the viewpoint of purchasing an IRA from the perspective of the individual.

**FIGURE 1
INDIVIDUALS (SHORT PUT)**



The exercise price is always 0. For example, if an individual lost their employment and needed resources to support their life style until they obtain new employment, the individual would be compelled to pay the withdrawal penalty to obtain the resources to support their life style.

The interesting thing of the structure of this short put is that everyone (within the same marginal tax bracket) receives the same tax break at the time of investment. In other words, they receive the same premium for taking the short position on the put. However, the volatility of working capital varies by individual and therefore the value of the put option also differs by individual. The result is the same put option premium for everyone but many different put option values.

Individuals that are paid a stated salary usually have little volatility in income and therefore little volatility in working capital. These people would be more likely to enter into the short position than someone that gets paid strictly on commission and has a higher volatility of working capital. Greater volatility would lead to a higher value being placed on the put and, therefore, less incentive to short the put option.

To conclude, all individuals will receive the same premium from entering into the short put, but everyone will place a different value on the put option. Table 1 summarizes the similarities of an Equity Short Put Option and investing in an IRA. There are some restrictions to IRA investing but beyond those the only difference is the tax break and the possible early withdrawal penalty.

TABLE 1
THE EFFECTS OF CHANGES IN VARIABLES TO THE VALUE OF THE PUT OPTION

Variable	Equity Short Put Option	Invest in IRA
Premium	Agreed upon by the buyer and seller	Equal to the tax break at current marginal tax rates
Exercise Price	Agreed upon by the buyer and seller	When the individual has negative working capital
Date of Exercise	When buyer chooses and is in-the-money.	When individual has negative working capital
Payout	Difference between stock price and exercise price	Withdrawal Penalty of IRA (10% of withdrawal amount)

ANALYSIS

Changes in Option Value

This comparison of IRAs and option values allows us to use option pricing to determine the effect of investing in an IRA. The price (or income) of the put is fixed, therefore one will sell the put if the perceived value is less than the income from selling the option. The perceived value of the option will change as variables associated with option change. Specifically, the option will increase in value when there is a longer time to expiration or if volatility increases. The option will decrease in value if working capital increases or if the risk-free rate increases. Table 2 shows the effects of changes in variables to the value of the short put option.

TABLE 2
THE EFFECTS OF CHANGES IN VARIABLES TO THE VALUE OF THE PUT OPTION

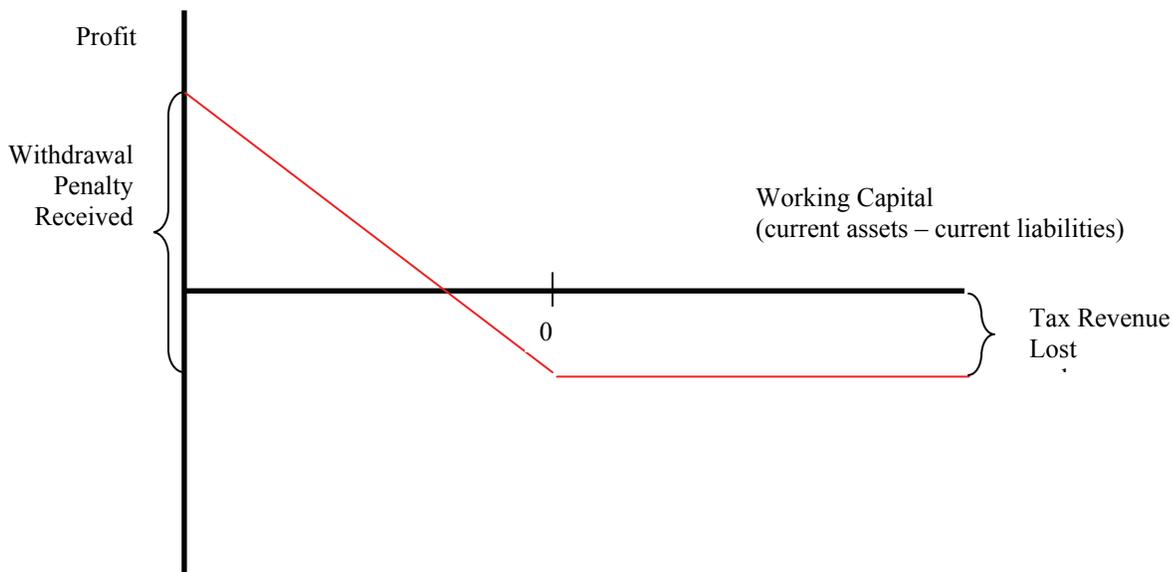
Increase in:	Change in Value of Put Option	
Working Capital	-	The more working capital, the less the implied value of the option.
Time to expiration	+	The longer the time-to-expiration, the more the implied value of the option.
Volatility	+	The greater the Volatility, the more the implied value of the option.
Risk-free rate	-	The greater the risk-free rate, the less the implied value of the option.

Therefore, individuals will less likely invest in an IRA when they are young, if their working capital is volatile, if they have less working capital, or when the risk-free rate is high.

Government Analysis

This same analysis can be done from the viewpoint of the government. If the individual is the seller of the put option then the government would be the buyer of the put option. As the buyer, the government pays the tax break that the individual is receiving from the put option. Figure 2 displays the viewpoint of issuing an IRA from the perspective of the government or IRS.

**FIGURE 2
GOVERNMENT (LONG PUT)**



By this analysis, the government would assume the role of purchaser of the put option and exercise whenever the individual is financially distressed (working capital < 0). Therefore, one analysis that could be done would be to estimate the value of extending the age at which individuals can withdraw their money from the IRA and consequently increase the value of their put option by extending the time to maturity.

ISSUES AND FURTHER RESEARCH

Our comparison of IRAs and put options allowed us to gain some insight into variables that effect the purchase decision. We acknowledge that there are a few differences between IRAs and option values, but this does not take away from the analysis. For example, the value of the IRA account grows over time and consequently the amount of the withdrawal penalty (value of the put option) would be changing over time. Also, the volatility of an individual's working capital changes over time, although it can be assumed to be constant for simplicity.

This research could be used for practical purposes by using a Monte Carlo simulation to determine what volatility of working capital would equate the premium received (taxes saved) to the value of the short put (withdrawal penalty). This would allow individuals to make strategic decision on investing in an IRA.

CONCLUSION

This paper examines the decision of investing in an IRA by comparing to selling a put option. The analysis allows option theory to make conclusions on how certain variables will affect the IRA purchase decision. Volatility in income and working capital are the two main determinants that an individual should use in their decision. Individuals should shy away from IRAs when their income stream is too volatile and/or when their working capital is too small.

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