A not so revolutionizing tax reform

A comparative study of the Swedish Investeringssparkonto and capital gains account

Johan Åberg[1] Jonatan Arblom Sundblad[2]

Stockholm School of Economics

Bachelor´s Thesis in Finance

May 14, 2018

Abstract

In this thesis, a comparison of profitability is made between two different kinds of savings accounts, the regular capital gains account and the Swedish Investeringssparkonto (ISK account). The implementation of the Investeringssparkonto on the Swedish personal investment market led to major changes for investors and the account has become a favorite of many advisors. A model is built for comparison between the two and the determining parameters for profitability are estimated using variable methods, such as an EGARCH model. We find that the use of an ISK account is favorable with a shorter investment horizon, but that the capital gains account is more profitable in the long term.

Keywords: Investeringssparkonto, ISK, capital gains tax, taxation, EGARCH

Tutor: Håkan Thorsell

Acknowledgements: We would like to thank Håkan Thorsell for his valuable input during the writing of this thesis.

[1] 23686@student.hhs.se
[2] 23700@student.hhs.se

Table of Contents

1 Introduction

Capital gains and losses have traditionally been taxed when the capital asset is liquidized, not when the actual gains and losses occur. This has for a long time been the only way of taxing assets and still is in many countries. In Sweden a new kind of savings account has been introduced, with gains and losses taxed as they occur (by taxing the entire asset value), the Investeringssparkonto (ISK). For this reason, it is only possible for market-valued assets to be held on an ISK account. The difference between ISK and capital gains taxation is both the level and scope of taxation, but also that the ISK account does not offer any ability to deduct losses in other accounts or assets types nor to deduct other losses from ISK profits. (Skatteverket, 2018)

The ISK per year tax rate has for the investor later proven more profitable than the capital gains tax rate used in regular capital gains accounts on a short-term basis, which has led advisors to praise the account in the media. (Småsparargiden, 2018, Privata affärer, 2018, Pensionsmyndigheten, 2018) The deductibility of a regular capital gains account might however be more profitable should the investment period be longer. The purpose when ISK first was implemented was to create an equally taxed holding account. (Skatteverket, 2018)

2 Background

ISK was first proposed by Aktiespararna (2010) as a mean to simplify the taxation process. It was never the purpose to provide people with an opportunity to lower their tax rate. The Swedish Ministry of Finance (2010) concluded in its memorandum that the effective tax rate initially would be hard to estimate but was approximate to the capital gains tax. It was the objective of the Swedish Ministry of Finance to provide a similar effective tax rate on the ISK as the capital gains account. A vastly superior savings account with a lower tax rate would make the government lose out on tax revenues, something they deemed unwanted. One of the positive things that the ISK would bring was however a lessened administrative burden for the Swedish Tax Agency. This they believed could possibly offset any form of tax reduction should the ISK account have had a lower tax rate than the capital gains account. In its memorandum, Sweden´s Ministry of Finance also argued that the implementation of ISK could provide the government with a steadier flow of capital since ISK have a yearly tax based on the actual asset value.

Even though the introduction of the ISK system radically changed the way of Swedish private savings, there is a lack of research on the differences between the new ISK and the capital gains account. Mårtensson and Nordström Löf (2012) conducted an investigation of a similar topic trying to compare ISK against a capital gains account. They simulated two investment strategies, one active and one passive and compared the returns from these two on the different saving accounts. They found that a more active investment profile with dividend paying stocks suited the ISK better than a capital gains account. On the other hand, a more passive investment approach with a longer investment horizon was fit for capital gains account. They also draw the conclusion that the government borrowing rate was essential to how well an ISK would perform. The simplification of the taxation process with the ISK account for private investors is something the authors believe could increase the amount of private investors.

Larsen and Nyquist (2014) conducted their comparative study of ISK against capital gains account with a different approach using a variant of option theory and dynamic programming. They also examined the tax effect should the investor change her holding account. Their goal was however not a simple comparison but to suggest how to enhance customer value by offering the right savings account. Several key parameters were used mutually between Mårtensson & Norström Löf (2012) and Larsen & Nyquist (2014) such as government borrowing rate and capital tax. Long-term adjustments to rates and expected return are however left out. Larsen and Nyquist (2014) conclude that using the right savings account could provide customer value since the right savings account provides a better after-tax return.

We aim to build upon the previous research by creating our own model to compare the accounts and lay a basis for further research.

3 Theory

With assets being taxed only at liquidation, as with the capital gains account, the investor has an opportunity to time the realization of gains and losses, therefore lowering the present value of the tax payments stream, by realizing losses as they occur and the capital gains as late as possible. This is shown by Constantinides (1983) who also presents a case for the timing option of any asset that is taxed only at liquidation. This timing option consists of selling an asset as soon as there is a loss, which can then be deducted from gains of the same size. Any

gains that surpass the loss should be kept as long as possible, i.e. until forced liquidation. This strategy of deferring tax is profitable since the deferred tax generates a revenue that in one time period would be

$$(profit_{t-1} * tax\ rate) * interest\ rate$$

The profit on deferred tax is not applicable when taxation is forced every year as with the ISK account type of taxation. The ISK account is a form of taxation where all capital assets are taxed at a certain percentage every year. The percentage is calculated by taking the adjusted government borrowing rate (SLR) multiplied by the capital gains tax. This leaves no room for deferring tax, but only taxes the gains and losses as part of the change in the assets value.

$$t_{ISK} = t_c * \max(lowest\ approved\ ISK\ rate; (SLR + fixed\ increase)$$

Intuitively, when there is no forced liquidation, at some point in time, the regular account would always be more profitable than an ISK account due to its possibility to defer tax on capital gains. In practice however, this might not be even plausible to analyze, as an investor might want to realize profits in order to get liquid means or to shift to a more profitable asset. For personal finance, where people might want to liquidize assets in order to buy a house, car or have as pension or college means, there is a definite time limit. It is then more reasonable to assume that investors might want to hold assets for a limited time.

Dividends on a capital gains account are taxed as they are realized, i.e. when the dividend is yielded. On an ISK account, the dividend is taxed as part of the full value of the assets held on the account.

A change in the capital gains tax would have direct implications on the capital gains account, but in the ISK account only indirect as part of the ISK-tax formula presented above. Thus, a change in capital tax would affect both the capital gains account and ISK account. The level of tax for the ISK account is a function of the government borrowing rate.

The government borrowing rate is a part of the ISK tax and therefore affect only the profitability of the ISK account.

4 Hypothesis

Our hypothesis is that the ISK account is favorable over a capital gains account on a short-term basis while it is outperformed by the capital gains account in the long term. We believe that we will see the capital gains account becoming relatively less profitable with higher dividend yield due to the dividends only being affected by taxation in this account. We further believe that higher returns will increase the initial relative profitability of the ISK account, but increase the relative loss for the ISK account in the long term. We also believe that an increase in the government borrowing rate will lead to the ISK account becoming relatively less profitable over all time periods.

5 Method

Our method for trying our hypothesis is to create a model that could be used to forecast the profitability of the two account types, as well as being adaptable in respect to each of the parameters. (5.1) To find out which account is more profitable we make assumptions regarding the different parameters and when possible, we look at the trend over time. (5.2) Using algebraic methods, we also find the points in time when the accounts are equally profitable for different adjustments to the parameters. Due to rounding errors, there might exist small differences when doing different calculations.

5.1 Model

In order to determine the most profitable account we have constructed a model that incorporates several key parameters that an investor might want to adjust; annual return, dividend yield, capital gains tax level, government borrowing rate, and volatility. Using this model, we will show how each parameter affects the profitability. We further provide graphs to give the reader an idea of the circumstances under which the ISK account might be more profitable than a regular stock account. We will also create an Excel file so that any investor or advisor could determine which account to use for a given asset given their own specific values. The model has been tested by doing the corresponding calculations for a number of the model calculations. The analysis is (unless otherwise stated) made with adjustments only to the parameter examined and observed over time. When comparing profitability, the relative profitability is always a positive number for ISK and a negative number for a capital gains account.

For the capital gains account the model is as below (Equation A1)

$$V_T = V_0 * (1+r)^T * \left((1-d) + d * (1-T_c)\right)^{T-1} * (1-T_c) + V_0 * T_c + V_0 * d * (1-T_c) * \sum_{i=1}^{T} (1+r)^t * \left((1-d) + d * (1-T_c)\right)^{t-1}$$

For the ISK account the model is as below (Equation A2)

$$V_T = V_0 * (1+r)^T * (1-T_{ISK})^T$$

Where V_0 is the initial value invested, V_T is the at time T value of the asset and accumulated dividends, r is the expected return, d is the dividend yield, t_C and t_{ISK} is the capital gains tax and the ISK tax respectively.

For t_{ISK} the model can be further broken down

$$t_{ISK} = t_c * max(lowest\ approved\ ISK\ rate; (SLR + fixed\ increase)$$

Where SLR is the government borrowing rate, $lowest\ approved\ ISK$ is the lowest rate of SLR that is allowed, and $fixed\ increase$ is a fixed increase of one percentage point that is required by law.

For the additional volatility analysis, the model has been adjusted for the capital gains account as below (Equation A3)

$$V_T = V_0 * ((1+r)^T \pm \sigma\sqrt{T}) * \left((1-d) + d * (1-T_c)\right)^{T-1} * (1-T_c) + V_0 * T_c + V_0 * d * (1-T_c) * \sum_{i=1}^{T} (\left((1-d) + d * (1-T_c)\right)^{t-1} * ((1+r)^t \pm \sigma\sqrt{T}))$$

Moreover, for the ISK account (Equation A3)

$$V_T = V_0 * ((1+r)^T \pm \sigma\sqrt{T}) * (1-T_{ISK})^T$$

With σ being the annual volatility of the asset.

To further incorporate into the ISK model the ability for the SLR to increase or decrease over time, we adjust the model accordingly (Equation A4)

$$V_T = V_0 * (1+r)^T * \prod_{i=1}^{T} \left(1 - T_c * max\left(lowest\ allowed\ SLR;\ \left(SLR + fixed\ increase \pm t * variable\ increase\right)\right)\right)$$

In order to take into account the risk-free interest rate of a market, the expected market return, and how an assets relate to market, the future returns r_A can be calculated using the Capital asset pricing model. (Markowitz, 1952, Sharpe, 1964, Lintner, 1965).

$$r_A = r_f + \beta(r_M - r_f)$$

Where r_A is the asset return, r_f is the risk-free rate, r_M is the market return, and β is a factor of correlation between the asset return and the market return.

For our thought asset, an index of the OMXS30, the correlation to the market is by definition 100 percent, which gives a β of 1. Solving the equation, this entail that the return of the asset is equal to the return of the market.

$$r_A = r_f + 1 * (r_M - r_f)$$

$$r_A = r_f + (r_M - r_f)$$

$$r_A = r_M$$

The return of the market could have been connected to the risk-free interest rate, in our thesis the government borrowing rate, but the market risk premium $(r_M - r_f)$ necessary for this gives us no conclusive result. Instead, the return of the market will be further examined in 5.2.1 below.

When measuring relative profitability in this thesis we use the following model so that when comparing the figures, we are indifferent to whether ISK or Capital gains account is more profitable. This will adjust the measurement so that when any of the two account types are more profitable than the other, the percentages will be comparable.

$$Comparison = \frac{Absolute\ difference}{min(ISK, CGA)} = \frac{ISK - CGA}{min(ISK, CGA)}$$

5.1.1 Limitations to the model

The model used for this analysis is not able to analyze historic figures, and it is therefore impossible to try out the optimal strategy presented by Constantinides (1983) with regards to the realization of losses. As the model simplifies returns by assuming constant returns, there is no reasonable situation where stocks incur losses. If losses are to occur, the best practice would be to realize them and make a new estimation of which account to use. In any case, it is true that losses are always relatively more profitable in a regular capital account as these would be deductible from gains and in an ISK account be taxed as they tax any capital on the account, not taking into account whether there are actual gains.

The value of any given asset is measured in the after-tax profitability, i.e. if the assets were to be liquidated at a given point in time. This is done to make the regular capital gains account and the ISK account comparable. The model is simplified, assuming that everything happens at the end of the year. While this is not a valid assumption, the impact of a single year has less effect when speaking of several decades of accumulated wealth. For the ISK account, which in reality would base its taxation on the value of the account every quarter of a year; this is possibly an even harsher assumption. For both of these assumptions we assume that the effect will not be material when comparing long time-periods. Further, it should be said that to be fully correct, the actual payment of taxes varies from person to person and while a profit might be realized in January, the taxation does not happen until the following year. This would be hard to incorporate and we have therefore not cared for any of these adaptations. For the reader it should however be said that this model will not be correct for short term investments and should rather be used to compare different long term and long term with short term investments. We assume no courtage or transaction costs when computing these values. We further assume that the effective ISK tax rate, capital gains tax rate, or the dividend yield will not exceed 100 percent.

5.2 Setting the standard parameters

In an effort to estimate future parameters used in our main model, historical values of set parameters are collected. These are used first to perform a long-term comparison but are also later individually examined.

5.2.1 Return

We have computed average annualized yearly growth over 32 years from our dataset of OMXS30 1986-2018 using

$$Average\ annual\ return\ = \frac{Ending\ value}{Starting\ value}^{\frac{1}{years}} - 1$$

Figure 1 OMXS30 Index 1986-2018

Figure showing the monthly OMXS30 index for the period 1986-2018

Total growth corresponds to 1,100 percent, which annualizes into an overall yearly growth of 7.99 percent on average.

This annualized value will be used in our standard parameters.

5.2.2 Dividends

Since our index do not incorporate dividends, we chose to not have any dividends in our standard setting. However, for companies on the stock exchange it is common to give some percentages in dividend yield.

We conclude that using zero dividend yield is not true for all asset types, but that this is reasonable when investing in index funds that follow the dividend excluded index. When looking at returns and dividend together we have chosen to use only the return of the index and lessen that by any dividend yield.

5.2.3 Capital gains tax

The current Swedish capital tax is set at 30 percent. The last major reform of the tax system was done in the 1990´s where the capital and corporate tax rate was decreased in order to attract investments and companies. (Carroll et al., 2012). In a recent industry report, the authors draw the conclusion that the tax pressure on individuals in Sweden was exceptionally high compared to other countries in the EU, OECD and BRIC countries. Sweden's capital taxes are above the average in Europe. While the overall capital tax rate was reduced from 20.8 percent in the early 2000´s to 14.9 percent today in other countries, Sweden remain at its level of 30 percent. (Fredriksson and Abdali, 2016) This leads us to believe that a decrease in capital tax in the future is not unlikely. This is however more dependent on political forces, which is beyond the scope of this paper. For the purpose of this paper, an assumption of fixed or slightly decreasing capital gains tax from now on is reasonable.

5.2.4 Government borrowing rate

Data of annual government borrowing rates from 1986-2018 were gathered from the Swedish National Debt Office and plotted in a graph. (Riksgälden, 2018)

Figure 2 Government borrowing rate 1986-2018

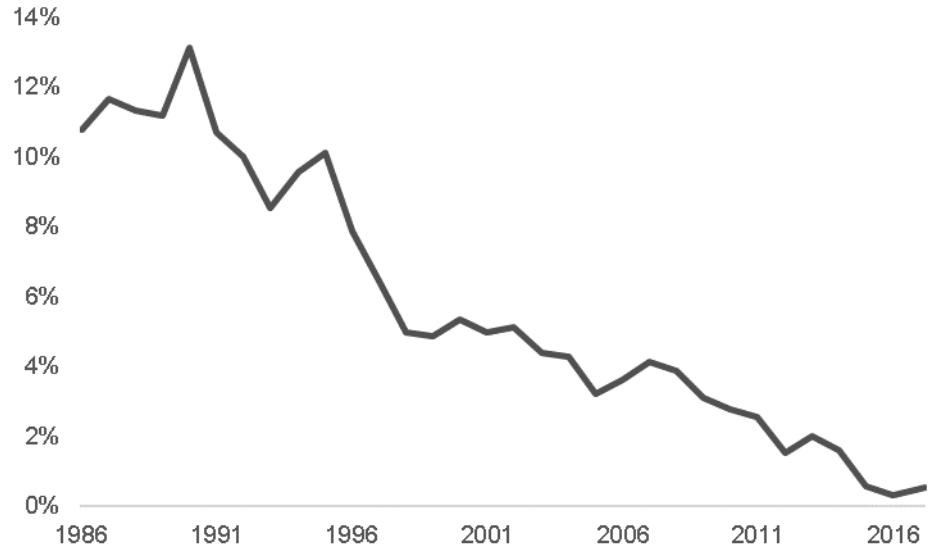


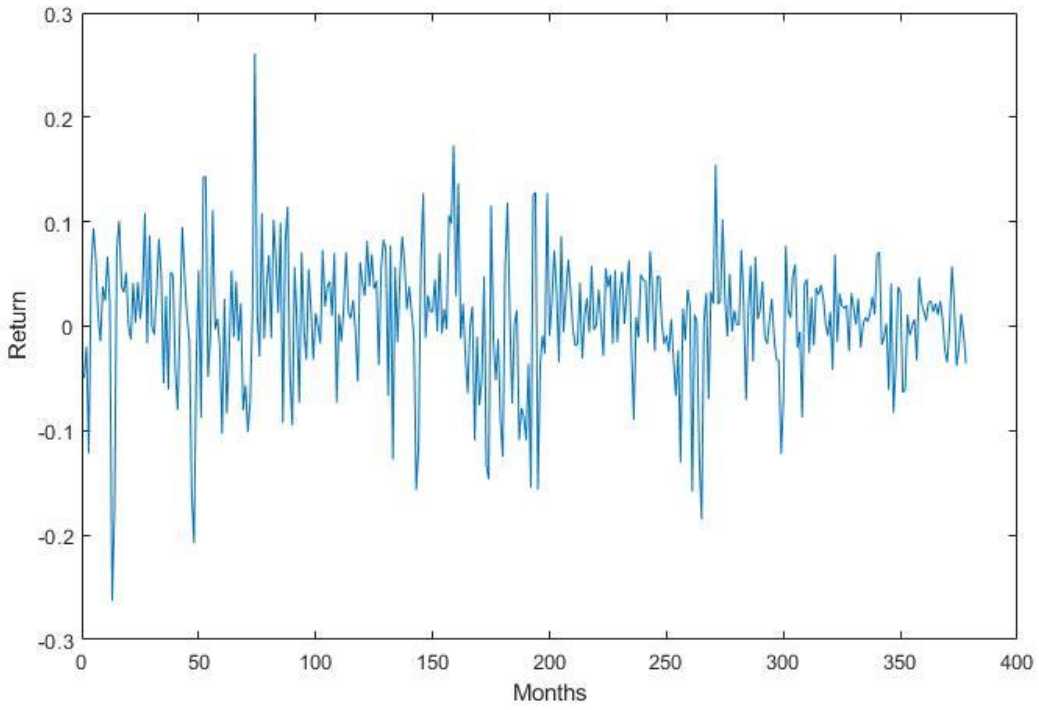
Figure showing the annual SLR rate for the period 1986-2018.

Over the last 32 years, the government borrowing rate has decreased over time. It is currently at 0.49 percent. The current rate is below the rate it was when the ISK account was first implemented. In 2010 when the ISK account was first introduced, the stable government borrowing rate that was used by the Ministry of Finance was set at 4.9 percent. (Finansdepartementet, 2010) These rates were thought to be fixed over the foreseeable future. They did however continue to fall. Should the borrowing rate remain at a low level it will result in a lower effective tax rate on ISK. The risk-free rate on the Swedish market is often determined by Swedish 10-year-old bond. (Frennberg and Hansson, 1992) A prognosis for the Swedish 10 year old bond (on which SLR is based) from 2018 to 2027 from National institute of Economic Research (2018) concluded an increase in the bond yield up to 3.6 percent in 2027. This overall trend of an increase in the government borrowing rate is concurrent with our calculated average over 32 years, which will be used in this paper.

5.2.5 Volatility

In order to review historical volatility, we plotted the logarithmic returns of our dataset from OMXS30 1986-2018. (Figure 3)

Figure 3 Monthly logarithmic returns



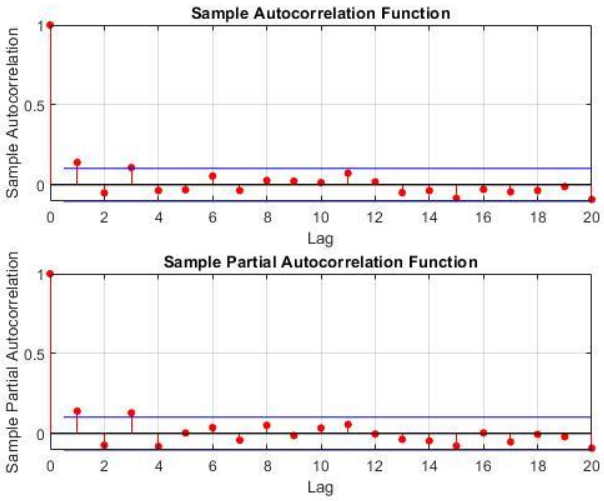
MATLAB. Picture showing the monthly logarithmic returns over our dataset OMXS30 over its 378 month period. Picture shows spikes and large changes in return are followed by another large change. The picture illustrates the concept of volatility clustering

As can be seen in the above figure the return showed several clusters of volatility, certain time periods with more intense returns and volatility. To forecast volatility based on historic data and to take into account the volatility clustering we need to find a proper method.

One of the more prominent models used in todays´ world for forecasting volatility, is the Autoregressive conditional heteroscedasticity based family of models (ARCH). (Brailsford and Faff, 1996) The original ARCH model was developed by Engle (2003). It uses previous historic data to forecast volatility, i.e. utilizes an autoregressive function. The ARCH family of models are used when there is an existing volatility clustering as it relies on heteroscedasticity. To further incorporate this clustering in volatility we use a model with a moving average when forecasting volatility, the Generalized autoregressive conditional heteroscedasticity model (GARCH model) (Bollerslev, 1986. Equation B1)

In order to determine if we could use a GARCH model it was important to check for any significant autocorrelation in our sample. If there is none we cannot use it. To do this, a correlogram was used. Since there was prominent autocorrelation in our sample data and also decreasing with the amount of lags as seen in Figure 4, a GARCH model is applicable.

Figure 4 Autocorrelation



MATLAB. We plotted with lags of 20. Two plots were created, one for Sample Autocorrelation function and one Sample Partial Autocorrelation function. Both show significance on α=0.0167 for the first five lags. Significant on $\alpha = 0.1$ for following lags. A prominent autocorrelation exists that decreases over the amount of lags.

In addition to Bollerslev model (Equation B1) we further use the Exponential General Autoregressive Conditional Heteroscedasticity (EGARCH) based on Nelson´s (1991) work. (Equation B3) The advantage of using an EGARCH model over the regular GARCH is that it allows for negative terms, while still keeping the variance positive. It also take into account the more violent market reactions to negative returns than to positive ones. (Alexander, 2008)

We are able to determine the long-term volatility through both the GARCH and the EGARCH function and to test which is better we run a number of tests. (Equation B2 and B4)

One of the tests is to see which model fits our error terms best, and to do that we break the normal distribution assumption of the error terms and compare a normal distributed error term with a Student t distribution. Our comparison is founded on Log-likelihood function (LLF).

In the EGARCH model, under the assumption of normal distribution in the error terms, we receive a high LLF. (Table B3) Using Student t's distribution for the EGARCH model gives an even higher LLF than its normal counterpart. (Table B4) Thus, a Student t distribution with 5 degrees of freedom is preferable over the other since it explains the distribution of the error terms better. The same comparison is done for the GARCH models where the student t-distribution is favorable. (Table B1 and B2) For historical analysis of the stock markets, a student t-distribution is preferred over a normal distribution. (Su, 2010) A

generalized error distribution (GED) could have proven beneficial should the error term exhibit disproportionately long tails. (Czyżycki, 2013) We did not notice any extreme tails in residual. We did not compute the model using a GED. Comparing the GARCH model with the EGARCH we notice a slightly higher LLF overall in favor of EGARCH. This is in line with empirical studies of financial data. (Brandt and Jones, 2012, Hansen and Lunde, 2005)

With all this testing, we conclude that using an EGARCH model with a Student t distribution of 5 degrees of freedom for the error term in order to estimate future volatility is the most accurate, given our data set.

Calculating the long-term volatility on a monthly basis with the EGARCH model resulted in a monthly volatility of 6.51 percent, which corresponds to an annualized volatility of 22.54 percent.

5.2.6 Standard parameters conclusion

Table 1 Standard parameters conclusion

	Return	Dividends	CG tax	SLR	Volatility
Set	7.99%	0%	30 %	5.64%	22.54%
Note		Can be more	Decreasing		

Table showing the starting parameters

6 Analysis

Using the model, we find that with the standard set of parameters the ISK account is more profitable than the regular capital gains account only for a short time period. The point in time when the two accounts are equally profitable is at 5.05 years. For time periods beyond this, the capital gains account is more profitable as can be seen in Figure 5.

Figure 5 Relative profitability of the ISK account with starting parameters

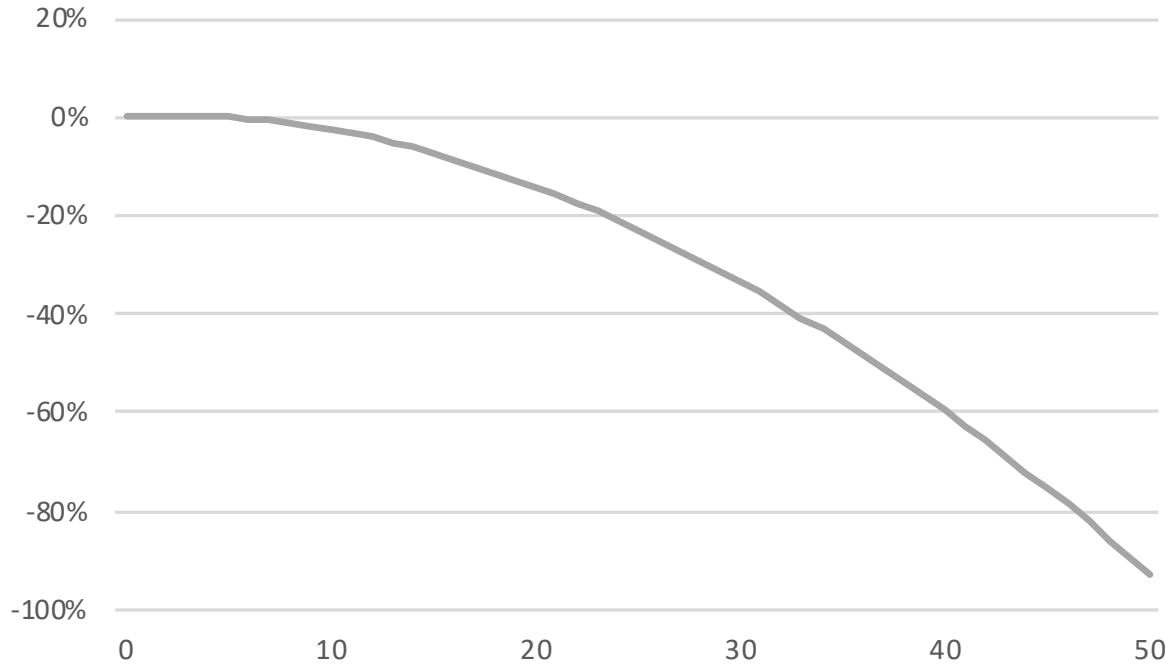


Figure showing the relative profitability of the ISK account for the starting parameters over 50 years.

Looking at a shorter time period it is clear that there is little difference in profitability, while there is much greater difference at longer time periods. As has already been mentioned this model is more suitable for comparing the profitability of the different tax regimes over longer time periods or between longer and shorter time periods than comparisons over shorter time periods. By looking at the standard parameters for a period of 10 years it is however clear that there is little difference between the two types of accounts. To see how different parameters, effect the profitability of the respective account type, a look at return, dividend yield, capital gains tax, government borrowing rate, and volatility will follow below. There will also be further analysis of the different time periods, which is in itself not a parameter, but the period over which the ISK is more profitable than the capital gains account is impacted by the other parameters.

6.1 Return

With the standard set of parameters, the ISK account is more profitable until about 5.05 years when the capital gains account become more profitable. When comparing with 6 and 10 percent return, the corresponding time periods for which the ISK is relatively more profitable is 0 and 10.40 years. We find that there is a pattern of higher return leading to more

profitability for the ISK account in the short term, and to prolong the profitability of the ISK account as in Figure 6.

Figure 6 Relative profitability of the ISK account with changes in return

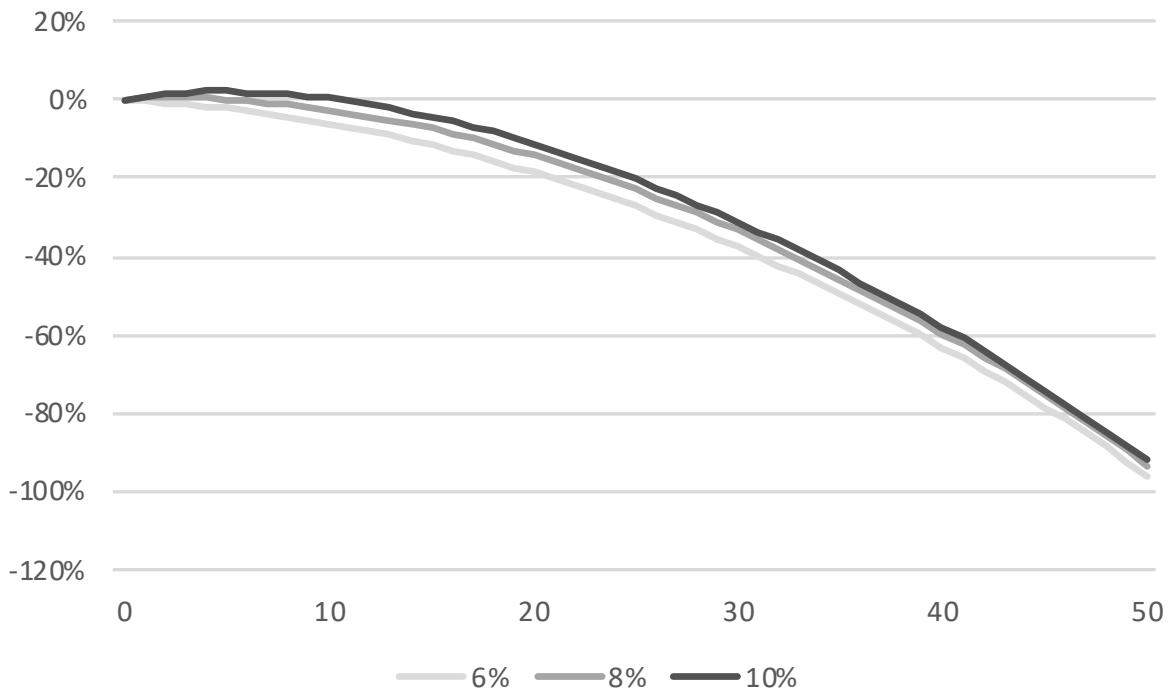


Figure showing the relative profitability of the ISK account for 6, 8, and 10 percent return over 50 years.

By comparing the ISK and capital gains account in Table 2 over different time periods and returns, it is further supported that the ISK is more profitable for higher rates of return and shorter time periods.

Table 2 Comparison with regards to return

	2%	4%	6%	8%	10%	12%	14%
1	-	-	-	+	+	+	+
5	-	-	-	+	+	+	+
10	-	-	-	-	+	+	+
20	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-

Table showing the relative profitability of an ISK (+) and a capital gains (-) account for different returns over different time periods.

We can further see that for periods over 20 years there is no rate of return for which the ISK is more profitable than the capital gains account. For periods of 1 to 20 years, the rate of return up until which the ISK is more profitable ranges from 7.11 to 9.80 percent. (Table C1)

Looking at the rates of return, we can see that for higher rates of return the period for which the ISK account is more profitable extends. For rates of return of 6 percent and below there is however not any time period for which the ISK account is more profitable. For rates of return as high as 14 percent, the ISK account is profitable for 14.73 years. (Table C2)

We can see that this analysis with our assumed parameters supports our hypothesis of the ISK being more profitable for shorter time periods and higher rates of return. We further see that with higher rates of return the period of relative profitability for the ISK account extends.

6.2 Dividends

By adding dividends to our standard parameters, it is possible to see at which time and at which dividend yield it is more profitable to use an ISK account and in which it is more profitable to use a regular capital gains account. The ISK account should according to our hypothesis be more profitable for shorter time periods and higher dividend yields, but this is not fully consistent with our analysis.

Table 3 Comparison with regards to dividends

	0%	1%	2%	3%	4%	5%	6%
1	+	+	-	-	-	-	-
5	+	-	-	-	-	-	-
10	-	-	-	-	-	-	+
20	-	-	-	-	-	-	+
30	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-

Table showing the relative profitability of an ISK (+) and a capital gains (-) account for different dividend yields over different time periods.

The ISK account is relatively more profitable below 1.09 and 0.17 percent dividend yield for 1 and 5 years respectively. It is further more profitable over 5.71, 5,95, 6.17, 6.29, and 6.37 percent dividend yield for 10, 20, 30, 40, and 50 years respectively as can be seen in Table 4. With these results, it seems to be that the ISK account is profitable for shorter periods

of time and lower dividend yields, as well as for longer periods and higher dividend yield, while there being a period and dividend yield in between for which the capital gains account is more profitable.

Table 4 Determining equal profitability – dividend yield and time

	Lower	Dividend yield (%)	Higher
1	+	1.09	-
5	+	0.17	-
10	-	5.71	+
20	-	5.95	+
30	-	6.17	+
40	-	6.29	+
50	-	6.37	+

Table showing the corresponding dividend yields for which the ISK and capital gains accounts are equally profitable over different time periods, as well as indications to which account type is more profitable for higher and lower yields.

As can be seen in Figure 7 with the standard setting of parameters and no dividend yield, the capital gains account outperforms the ISK in the long term. We have to add dividends of up to 8 percent for the ISK to become more profitable than the capital gains account in the long term.

Figure 7 Relative profitability of the ISK account with changes in dividend yields

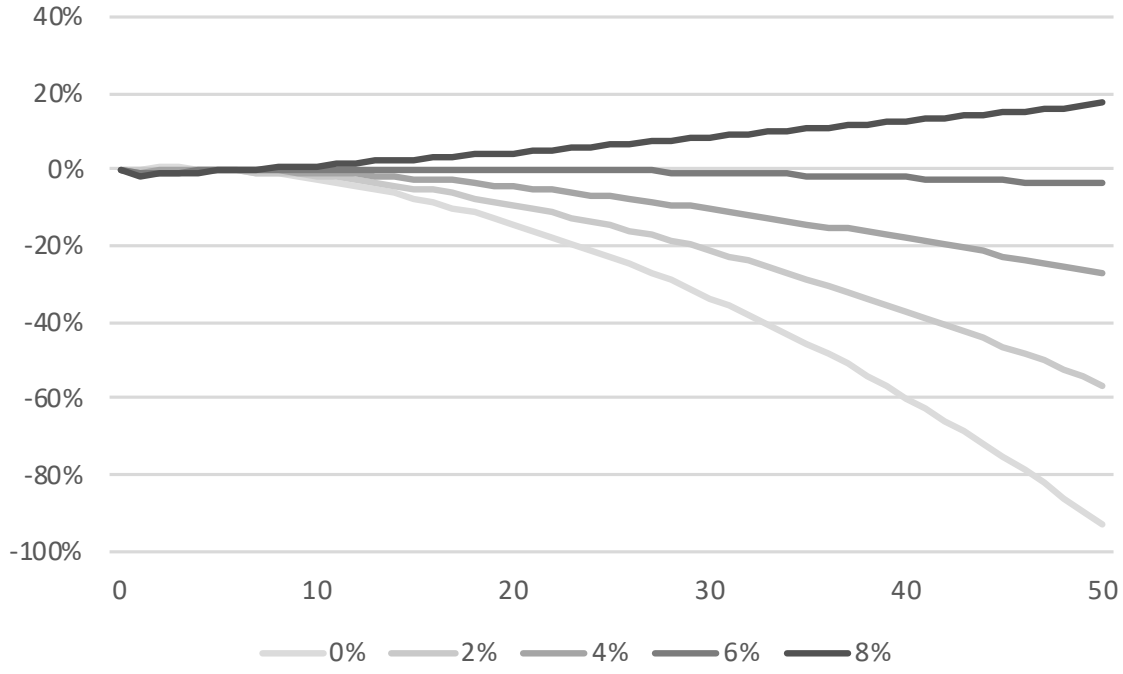


Figure showing the relative profitability of the ISK account for 0, 2, 4, 6, and 8 percent dividend yield over 50 years.

Looking at different levels of dividend yields in Table 5, rather than only time periods, we are presented with a much more complicated picture. As we can see from the graph, dividend yields of 6 percent and below are relatively more profitable for the capital gains account in the long term. We find that there for some levels of dividend yield exists periods where the ISK account is more profitable, but that for periods before and after these, the account is less profitable than the capital gains account. For some levels of dividend yields, there is no point in time when the ISK is as profitable as the capital gains account.

Table 5 Determining equal profitability – time and dividend yield

0%		+	5.05	-	
1%	-	0.89	+	4.70	-
2%	-	2.88	+	3.50	-
3%	N/A	N/A	N/A	N/A	N/A
4%	N/A	N/A	N/A	N/A	N/A
5%	N/A	N/A	N/A	N/A	N/A
6%	-	8.14	+	21.70	-
7%		-	6.92	+	
8%		-	6.51	+	

Table showing the corresponding time periods for which the ISK and capital gains account are equally profitable over different dividend yields, as well as indications to which account type is more profitable for longer and shorter time periods. For N/A, there is no point in time, when the ISK account is more profitable than the capital gains account.

We conclude for the dividend yields, that our hypothesis of higher yields being more profitable for the ISK account is correct, but that the picture is more complicated and there are periods and yield levels for which this is not the case.

6.3 Capital gains tax

When using our standard parameters and adjusting for the capital gains tax, the ISK account is more profitable for shorter time periods, but there seem to be little difference over higher or lower tax levels as can be seen in Table 6.

Table 6 Comparison with regards to capital gains tax

	5%	10%	15%	20%	25%	30%	40%
1	+	+	+	+	+	+	+
5	-	-	-	-	-	+	+
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-

Table showing the relative profitability of an ISK (+) and a capital gains (-) account for different capital gains tax levels over different time periods.

The corresponding tax rate where the ISK account becomes more profitable are for 5 years 29.84 percent and for 10 years 73.01 percent. For very short periods in time there is no tax levels for which the capital gains account is more profitable than the ISK and respectively, for time periods of 10 years and longer, there is no reasonable tax levels for which an ISK account is more profitable than a capital gains account. (Table C3)

When looking at different levels of capital gains tax, it is clear that there is not much difference in profitability for different tax rates. The capital gains tax-factor in determining which account is more profitable seems to be of little importance for our assumed parameters. (Table C4)

Plotting the profitability in Figure 8, there is a clear advantage of the capital gains account for time periods over 10 to 20 years and for time periods shorter than this there is not much difference.

Figure 8 Relative profitability of the ISK account with changes in capital gains tax

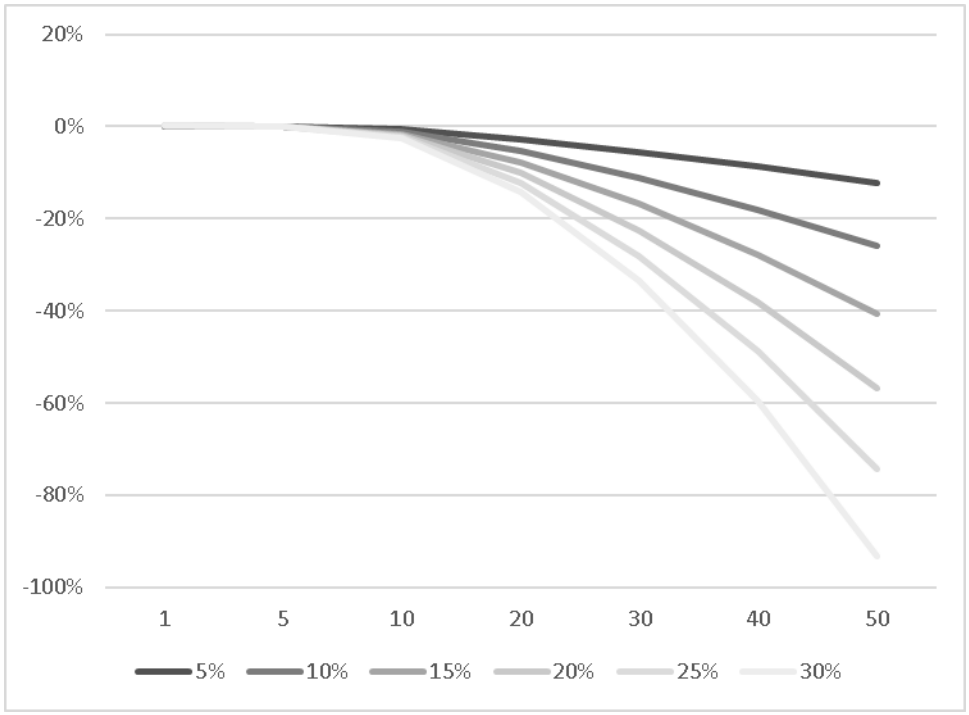


Figure showing the relative profitability of the ISK account for 5 – 30 percent capital gains tax over 50 years.

It is concluded that while the ISK account is relatively profitable for about 5 years regardless of what the capital gains tax level is, the relative loss of the ISK account over about 10 to 20 years is large. The capital gains tax-factor in determining which account is more profitable seems to be of little importance.

6.4 Government borrowing rate

With all parameters the same, except for the government borrowing rate and comparing profitability over time, it is shown that the ISK account is more profitable with lower SLR rates and shorter time periods.

Table 7 Comparison with regards to government borrowing rates

	0%	2%	4%	6%	8%	10%	12%
1	+	+	+	+	-	-	-
5	+	+	+	-	-	-	-
10	+	+	+	-	-	-	-
20	+	+	-	-	-	-	-
30	+	+	-	-	-	-	-
40	+	-	-	-	-	-	-
50	+	-	-	-	-	-	-

Table showing the relative profitability of an ISK (+) and a capital gains (-) account for different SLR rates over different time periods.

In the short term it is more profitable with an ISK account when the SLR is around 5 percent. This means that for an active investor with many trades it would on average, but only if the SLR is around or below average, be profitable to trade in an ISK account. In the long term, it is profitable with an ISK account only for lower than average SLR rates. (Table C5)

For SLR rates over 5 percent it would be more profitable to trade in a regular account, even in the short term. At 2.47 percent SLR rate the regular capital gains account becomes more profitable over 30 years. (Table C6)

As we have so far set the SLR to a fixed number the point in time where the capital gains account becomes relatively more profitable might be misjudged. By adding the possibility for the SLR rate to increase or decrease over time we will better capture the cycles of the SLR rates. This study only includes SLR rates from the past 32 years, which shows a steady fall in the rate. In the below Figure 9 the relative profitability of the ISK is tracked with one line for starting with a SLR rate of 12 percent, shrinking by 0.4 percentage points per year and the other is a line for starting with a SLR rate of 0 percent, growing by 0.4 percentage points per year. A decrease of 0.4 percentage points is roughly what the ISK has had for the last 30 years. Therefor the figure is presented over just 30 years. The conclusions from this is that starting with a lower SLR rate (0 percent) would make the ISK relatively profitable over a longer time period, while starting with a high SLR rate (12 percent) would make the capital gains account more profitable from the start. After 30 years there is little difference between the accounts and the case when starting from a low SLR is more profitable. This is due to the fact that lower SLR rates would have a greater impact in the beginning of the time period when the first capital accumulation takes place.

Figure 9 Relative profitability of the ISK when simulating increase and decrease in SLR

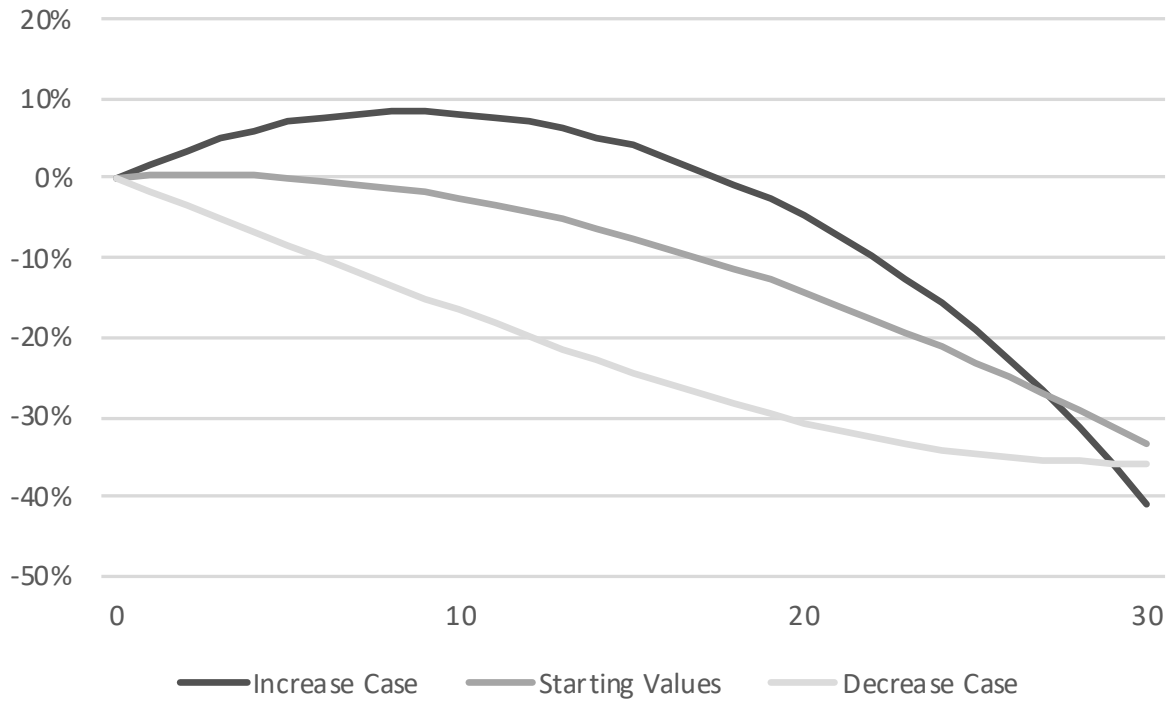


Figure plotting the starting values, as well as scenario for starting and 0 and 12 percent SLR rate and increasing and decreasing with 0.4 percentage points per year respectively over 30 years.

With this analysis, we can see that for our chosen parameters, our hypothesis that the ISK is relatively more profitable in short term and for lower SLR rates and vice versa for the capital gains account holds. We however also see that when starting at a low SLR rate the period for which the ISK is more profitable extends.

6.5 Volatility

When comparing the two account types it is shown that volatility does not affect the profitability in any substantial way for longer time periods.

Figure 10 Absolute profitability of the two accounts with volatility

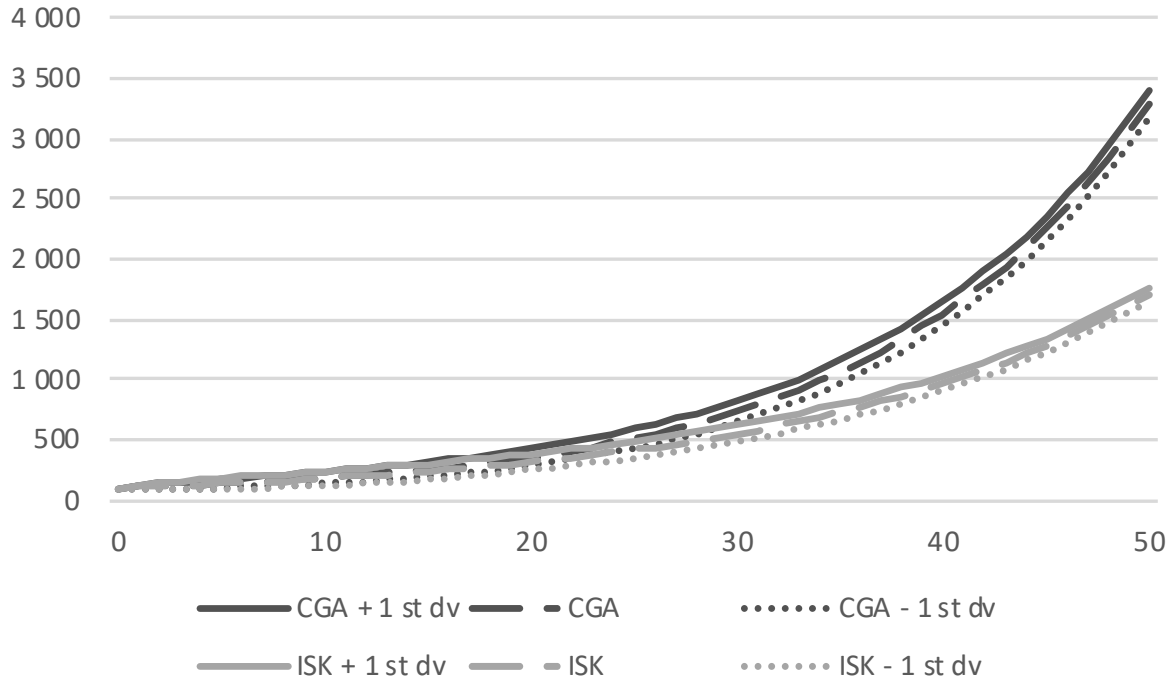


Figure showing the absolute profitability of the capital gains account (CGA) and the ISK account (ISK) for the standard settings as well as for one standard deviation volatility up and down over 50 years.

For shorter time periods it is however clear that one standard deviation of returns up seem to impact the ISK account more than the capital gains account, thus leading to higher return and prolonged relative profitability and one standard deviation of returns down leading to larger losses and the account never being relatively profitable. The point in time when the ISK and capital gains account are equally profitable for our standard deviation up is 11.42 years. This is almost twice as long as for the no-volatility case.

Figure 11 Relative profitability of the two accounts with volatility

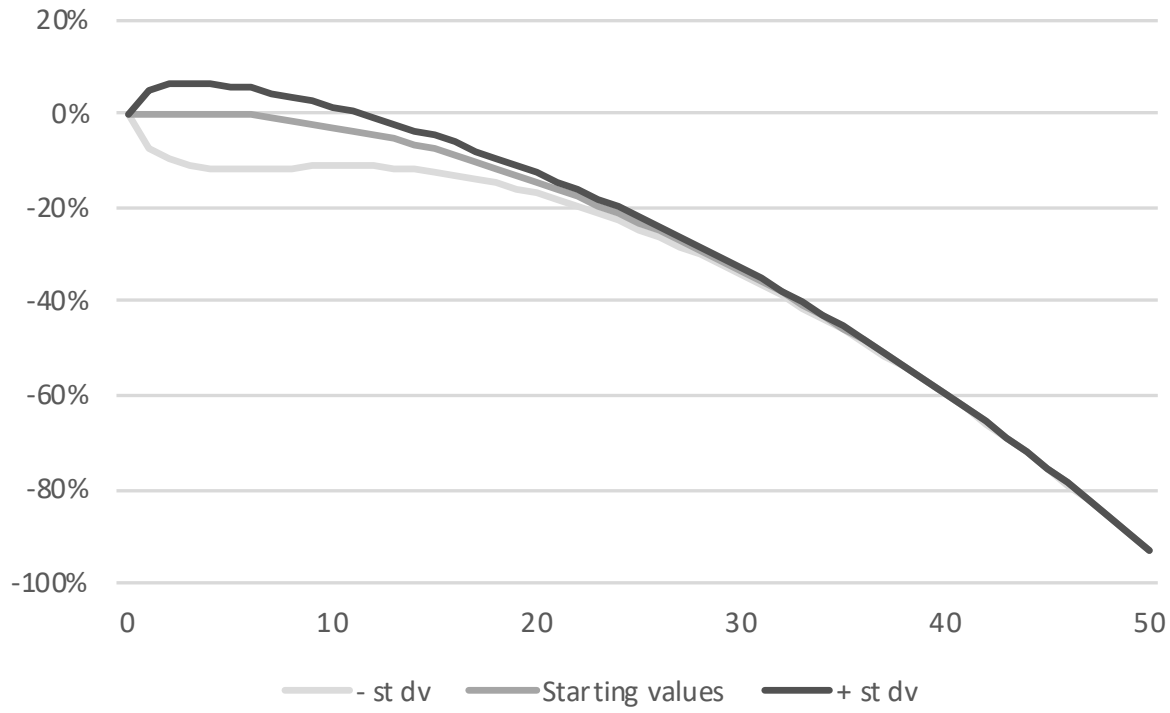


Figure showing the relative profitability of the ISK account for the starting values as well as one standard deviation volatility up and down over 50 years.

When looking at one standard deviation up and down for different levels of volatility and time periods, it is shown that higher volatility leads to the ISK account being relatively more profitable with one standard deviation up, thus extending the time period for which it is relatively more profitable. With one standard deviation down, the ISK is never relatively more profitable as can be seen in Table 8.

Table 8 Comparison of relative profitability with regards to volatility

+vol	0%	10%	20%	30%	40%
1	+	+	+	+	+
5	+	+	+	+	+
10	-	-	+	+	+
20	-	-	-	-	-
30	-	-	-	-	-
40	-	-	-	-	-
50	-	-	-	-	-

-vol	0%	10%	20%	30%	40%
1	+	-	-	-	-
5	+	-	-	-	-
10	-	-	-	-	-
20	-	-	-	-	-
30	-	-	-	-	-
40	-	-	-	-	-
50	-	-	-	-	-

Table showing the relative profitability of an ISK (+) and a capital gains (-) account for different an up and a down outcome of volatility over different time periods.

Seeking the volatility level for which the ISK is more profitable than the capital gains account it is shown that for both 1 and 5 years, with one standard deviation up, there is no level of volatility for which the ISK account is less profitable than the capital gains account. For 10 years the volatility level is 12.37 percent, after which the ISK becomes relatively more profitable. With one standard deviation down, it is evident that there is no reasonable level of volatility for which the ISK account is relatively more profitable. (Table C7)

Seeking the time periods for which the ISK account is more profitable for set volatilities, it is clear that with higher levels of volatility the time periods for which the ISK is more profitable extends, from 5.01 years with no volatility to about 12.75 years for 40 percent volatility. With one standard deviation down, there is no level of volatility for which the ISK is more profitable. (Table C8)

We conclude that the ISK account is more sensitive to volatility and is more profitable than the capital gains account for a longer time period with an increase due to volatility and less profitable for a decrease due to volatility.

7 Conclusion

The analysis has shown that with the assumptions made the hypothesis of higher profitability for the ISK account in short term and higher profitability for the capital gains account in the long-term holds. The point in time where the capital gains account becomes more profitable is 5.05 years.

Our hypothesis of higher return being relatively profitable for the ISK account holds, but for periods of 20 years and beyond the capital gains account is always more profitable.

Our analysis has shown that our hypothesis of higher dividends and shorter time periods would be relatively profitable for the ISK account is correct. The results are however

somewhat inconclusive as there for many levels of dividend yield exist periods for which the ISK account is relatively profitable, but both before and after these periods the capital gains account is more profitable than the ISK account.

When looking at capital gains tax levels the relative profitability of the ISK account increases somewhat with higher tax rates, but the increase is limited.

Looking at the government borrowing rate our hypothesis that the ISK would be more profitable than the capital gains account with lower levels and over shorter time periods is correct. When simulating increasing government borrowing rates from a low starting point it is clear that the ISK account is relatively profitable for a longer time period. When starting at a high level and having the rate decrease, the ISK account never is relatively profitable.

We can see that the ISK account is more sensitive to volatility in that it with one standard deviation of returns up, will be relatively profitable for longer time periods, and with one standard deviation down be less profitable than the capital gains account from the start.

8 Discussion

The purpose of this paper was to compare and investigate the relative profitability between an ISK and capital gains account and what an investor should choose. The working hypothesis held true, but there were some new findings. The length of the investment horizon had a crucial part in deciding for when a capital gains account was preferable. Our findings are in line with previous research done by Mårtensson and Nordström Löf (2012) where an ISK account shows higher returns after tax for dividend paying stocks. The ISK account had a more prominent profitability regarding dividend yields than our thesis suggests. We believe it can be contributed to changes to the present economic climate with lower than average government borrowing rates that their thesis is based on. They also reach the conclusion that the government borrowing rate is essential to how well an ISK account will perform. The authors did also exclude deductibility from capital gains account in their model, which we believe could impact the outcome and might have caused the capital gains account to underperform.

While we in this thesis could not find any connection between the market return and the government borrowing rate, a more focused and extensive study could probably find a connection that would enhance the model further.

Incentivizing a longer investment period by choosing the capital gains account might stop the investor from choosing more profitable investment opportunities to reap the benefits of a capital gains account. This could be an interesting topic for further research.

Any form of policy change regarding ISK taxation might have dire impact on our comparison. During 2017, a proposal of an increase in the going-rate for ISK tax was done by the Ministry of Finance (2017). The nearly constant changes in legislation makes one wonder whether there is sound reasoning behind the ISK account and whether the relative profitability of the account in the short term will be prevalent in the future. This could be a topic of further research.

An important fact that should not be neglected is the ability to invest in both types of accounts. Depending on the investment horizon, the investor should tread carefully in what account she chooses. Diversification does not necessary only concern what stock to choose but also the way of saving and what losses are to be expected should the investor decide to change her savings account type. This could be of value for research on diversification and returns. Compared to previous studies our government borrowing rate is higher since we have computed an average while other authors have gone with the current going-rate. As a result of this, our model does not correctly value the ISK in the short term. It is however in line with our results that ISK is preferable over a shorter investment horizon. As mentioned previously, we expect an increase in the government borrowing rate in the coming years.

The implementation of the ISK account paved way a revolutionizing taxation system. The ISK account is however not always the optimal choice as many advisors seem to believe. This paper paves way for further research on this unexplored subject.

9 References

Public statutes and legislation

Swedish Ministry of Finance (Finansdepartementet), 2010, Schablonbeskattat investeringssparkonto och ändrad beskattning av kapitalförsäkring, Fi 2010/5534

Swedish Ministry of Finance (Finansdepartementet), 2017, Höjd beskattning av sparande på investeringssparkonto och i kapitalförsäkring, Fi2017/03543/S1

Litterature

Alexander, C., 2008, Practical Financial Econometrics, (John Willey & Sons).

Bollerslev, T. 1986, Generalized Autoregressive Conditional heteroscedasticity, Journal of *Econometrics*, 31, 1986, 307-327.

Brailsford, T., Faff, R., 1996, An evolution of volatility forecasting techniques, *Journal of Banking & Finance*, Vol 20, 419-34B.

Brandt, M., Jones, C., 2012, Volatility Forecasting With Range-based EGARCH Models, *Journal of Business & Economic Statistics*, Volume 24, 470-486.

Constantinides, G., 1983, Capital Market Equilibrium with Personal Tax, *Econometrica*, Volume 51, 611-636.

Czyżycki, R., 2013, Using GED (Generalized Error Distribution) for Modelling Distribution of the Rates of Return, University of Szczecin.

Engle, F., 2003, Risk and Volatility: Econometric Models and Financial Practice, *The American Economic Review*, Vol 94, 405-420.

Frennberg, P., Hansson, B., 1992, Swedish stocks, bonds, bills and inflation, *Applied Financial Economics*, Vol 2,79-86.

Hansen, R., Lunde, A., 2001, A comparison of volatility models: Does anything beat a GARCH(1,1)?, University of Aarhus and Brown University Economics working paper no. 01-04.

Larsen, J., Nyquist,H., 2014, Val av sparform vid aktieinvesteringar, Bachelor thesis, KTH Royal Institute of Technology.

Lintner, J., 1965, The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets, *The Review of Economics and Statistics*, Vol 47, 13-37.

Markowitz, H., 1952, Portfolio Selection, *The Journal of Finance*, Vol 7, 77-91.

Mårtensson, G., Nordström Löf,E., 2012, Investeringssparkontot – För schablonbeskattning – i tiden, Master thesis, University of Linköping.

Nelson, D., 1991, Conditional Heteroskedasticity in Asset Returns: A New Approach, *Econometrica*, Vol 59, 347-379.

Sharpe, W., 1964, Capital Asset Prices: A theory of Market Equilibrium under Conditions of Risk, *The Journal of Finance*, Vol 19, 425-442.

Su, C. (2010) Application of EGARCH Model to Estimate Financial Volatility of Daily Returns: The empirical case of China, Master thesis, University of Gothenburg.

Articles

Carroll, R., Pizzola, B., Hultman, E., Segerström, M., 2012, Corporate Dividend and Capital Gains Taxation: A comparison of Sweden to other member nations of the OECD and EU, and BRIC countries, Ernst & Young, written for the Confederation of Swedish Enterprise.

Fredriksson, T., Abdali, H., 2016, Konkurrenskraften i Sveriges ägarbeskattning, Grant Thornton, written for Confederation of Swedish Enterprise.

Electronic references

Aktiespararna, 2010, Regeringen vill införa ett investeringssparkonto, retrieved 2018-05-09 https://www.aktiespararna.se/Artikelarkiv/Opinion/2010/oktober/Regeringen-vill-infora-ett-investeringssparkonto

National Institute of Economic Research, 2018, Interest rates. Year, Data 2018-2027, retrieved 2018-05-05 http://prognos.konj.se/PXWeb/pxweb/en/SenastePrognosen/SenastePrognosen__f06_rantorochvaxelkurser/F0601.px/?rxid=36448a9a-aaa9-457b-8b85-ee02756d65a1

Pensionsmyndigheten, 2017, Trots höjd skatt – investeringssparkonto (ISK) fortfarande ett bra sparalternativ, retrieved 2018-05-11, https://www.pensionsmyndigheten.se/monicas-pensionsblogg/monicas-pensionsblogg/trots-hojd-skatt-investeringssparkonto-isk-fortfarande-ett-bra-sparalternativ

Privata Affärer,2013, Ska man börja spara i dag är ISK bäst, retrieved 2018-05-12 http://www.privataaffarer.se/sparabattre/ska-man-borja-spara-i-dag-ar-isk-bast-475823

Riksgälden, 2018, Government borrowing rate (SLR), retrieved 2018-03-31, data from 1986-2018, https://www.riksgalden.se/sv/omriksgalden/statsskulden/statslanerantan/

Skatteverket, 2018, Principer om kapitalbeskattning, retrieved 2018-03-04, https://www4.skatteverket.se/rattsligvagledning/2709.html?pk_vid=cc4292a92e0df8dc1523347326abc196

Skatteverket, 2018, Investeringssparkonto, retrieved 2018-03-10 https://www.skatteverket.se/privat/skatter/vardepapper/investeringssparkonto.4.5fc8c94513259a4ba1d800037851.html

Småsparargiden, 2017, Därför ska du sälja gamla fonder och skaffa ISK, retrieved 2018-05-11 http://www.smasparargiden.se/blogg/darfor-ska-du-salja-gamla-fonder-och-skaffa-isk/

Databases
OMXS30, monthly data 01/10-1986 to 01/04-2018, retrieved from
https://se.investing.com/indices/omx-stockholm-30-historical-data

10 Appendices

10.1 Appendix A Model

A1 Capital gains account model

With reinvested dividends the value of total assets in time t=1 would be the asset price and the value of the dividend paid in year t=1.

$$V_1 = A_1 + div_1$$

$$A_1 = V_0 * (1 + r) * (1 - d)$$

$$div_1 = V_0 * (1 + r) * d * (1 - T_c)$$

$$\begin{aligned} V_1 = A_1 + div_1 &= V_0 * (1 + r) * (1 - d) + V_0 * (1 + r) * d * (1 - T_c) \\ &= V_0 * (1 + r) * ((1 - d) + d * (1 - T_c)) \end{aligned}$$

With reinvested dividends the value of total assets in time t=2 would be the asset price and the value of the dividend paid in year t=2.

$$V_2 = A_2 + div_2$$

$$\begin{aligned} A_2 = V_1 * (1 + r) * (1 - d) &= V_0 * (1 + r) * ((1 - d) + d * (1 - T_c)) * (1 + r) * (1 - d) \\ &= V_0 * (1 + r)^2 * ((1 - d) + d * (1 - T_c)) * (1 - d) \end{aligned}$$

$$\begin{aligned} div_2 = V_1 * (1 + r) * d * (1 - T_c) \\ &= V_0 * (1 + r) * ((1 - d) + d * (1 - T_c)) * (1 + r) * d * (1 - T_c) \\ &= V_0 * (1 + r)^2 * ((1 - d) + d * (1 - T_c)) * d * (1 - T_c) \end{aligned}$$

$$\begin{aligned} V_2 = A_2 + div_2 \\ &= V_0 * (1 + r)^2 * \big((1 - d) + d * (1 - T_c)\big) * (1 - d) + V_0 * (1 + r)^2 \\ &* ((1 - d) + d * (1 - T_c)) * d * (1 - T_c) \\ &= V_0 * (1 + r)^2 * \big((1 - d) + d * (1 - T_c)\big)^2 \end{aligned}$$

With this pattern follows

$$V_T = A_T + div_T$$
$$= V_0 * (1+r)^T * \big((1-d) + d * (1-T_c)\big) * (1-d) + V_0 * (1+r)^T$$
$$* \big((1-d) + d * (1-T_c)\big) * d * (1-T_c)$$
$$= V_0 * (1+r)^T * \big((1-d) + d * (1-T_c)\big)^T$$

Noting that only the dividends have been taxed in this case, we need to go back a period to time t=T-1 and assume that the asset is sold the next year. This way, there is no difference in taxation of the dividend and the asset, so that we can add one year of return and tax the whole asset at the same level.

$$V_T = (A_{T-1} + div_{T-1}) * (1+r) * (1-T_c)$$
$$= V_0 * (1+r)^{T-1} * \big((1-d) + d * (1-T_c)\big)^{T-1} * (1+r) * (1-T_c)$$
$$= V_0 * (1+r)^T * \big((1-d) + d * (1-T_c)\big)^{T-1} * (1-T_c)$$

To incorporate the deductible initial value of the asset as well as for the reinvested dividends we add for the initial value

$$V_0 * T_c$$

For the reinvested dividend, as per previously stated

$$div_1 = V_0 * (1+r) * d * (1-T_c)$$

$$div_2 = V_1 * (1+r) * d * (1-T_c)$$
$$= V_0 * (1+r)^2 * \big((1-d) + d * (1-T_c)\big) * d * (1-T_c)$$

Furthering this

$$div_3 = V_2 * (1+r) * d * (1-T_{ISK})$$
$$= V_0 * (1+r)^3 * \big((1-d) + d * (1-T_c)\big)^2 * d * (1-T_c) =$$

Which entails that

$$div_T = V_0 * (1+r)^{T-1} * \left((1-d) + d * (1-T_c)\right)^{T-1} * (1+r) * d * (1-T_{ISK})$$
$$= V_0 * (1+r)^{T} * \left((1-d) + d * (1-T_c)\right)^{T-1} * d * (1-T_{ISK})$$

We now have the absolute value of the dividend at its yield. This value is then reinvested and only the profit it brings about should be taxed. To do this we add to the formulae a tax shield term of initial value at investment * Tc so that the accumulated reinvested dividends

$$Tax\ shield = T_c * \sum_{i=1}^{T} (div_1, div_2, div_3 \dots\ div_{T-1}, div_T)$$

We insert formulae

$$T_c * \sum_{i=1}^{T} (V_0 * (1+r)^{T} * \left((1-d) + d * (1-T_c)\right)^{T-1} * d * (1-T_{ISK}))$$
$$= V_0 * d * (1-T_c) * \sum_{i=1}^{T} ((1+r)^{t} * \left((1-d) + d * (1-T_c)\right)^{t-1})$$

The full model then is

$$V_T = V_0 * (1+r)^{T} * \left((1-d) + d * (1-T_c)\right)^{T-1} * (1-T_c) + V_0 * T_c + V_0 * d * (1-T_c)$$
$$* \sum_{i=1}^{T} (1+r)^{t} \pm \sigma\sqrt{T}) * \left((1-d) + d * (1-T_c)\right)^{t-1}$$

A2 ISK model

With reinvested dividends the value of total assets in time t=1 would be the asset price and the value of the dividend paid in year t=1.

$$V_1 = A_1 + div_1$$

$$A_1 = V_0 * (1 + r) * (1 - d) * (1 - T_{ISK})$$

$$div_1 = V_0 * (1 + r) * d * (1 - T_{ISK})$$

$$\begin{aligned} V_1 = A_1 + div_1 &= V_0 * (1 + r) * (1 - d) * (1 - T_{ISK}) + V_0 * (1 + r) * d * (1 - T_{ISK}) \\ &= V_0 * (1 + r) * \big((1 - d) + d\big) * (1 - T_{ISK}) = V_0 * (1 + r) * (1 - T_{ISK}) \end{aligned}$$

With reinvested dividends the value of total assets in time t=2 would be the asset price and the value of the dividend paid in year t=2.

$$V_2 = A_2 + div_2$$

$$\begin{aligned} A_2 &= V_1 * (1 + r) * (1 - d) * (1 - T_{ISK}) \\ &= V_0 * (1 + r) * (1 - T_{ISK}) * (1 + r) * (1 - d) * (1 - T_{ISK}) \\ &= V_0 * (1 + r)^2 * (1 - d) * (1 - T_c)^2 \end{aligned}$$

$$\begin{aligned} div_2 = V_1 * (1 + r) * d * (1 - T_{ISK}) &= V_0 * (1 + r) * (1 - T_{ISK}) * (1 + r) * d * (1 - T_{ISK}) \\ &= V_0 * (1 + r)^2 * d * (1 - T_{ISK})^2 \end{aligned}$$

$$\begin{aligned} V_2 = A_2 + div_2 &= V_0 * (1 + r)^2 * (1 - d) * (1 - T_{ISK})^2 + V_0 * (1 + r)^2 * d * (1 - ISK)^2 \\ &= V_0 * (1 + r)^2 * \big((1 - d) + d\big) * (1 - T_{ISK})^2 = V_0 * (1 + r)^2 * (1 - T_{ISK})^2 \end{aligned}$$

With this pattern, we can see that the dividend payments do not affect the taxation at an ISK account.

$$\begin{aligned} V_T = A_T + div_T &= V_0 * (1 + r)^T * (1 - d) * (1 - T_c)^T + V_0 * (1 + r)^T * d * (1 - T_{ISK})^T \\ &= V_0 * (1 + r)^T * \big((1 - d) + d\big) * (1 - T_{ISK})^T = V_0 * (1 + r)^T * (1 - T_{ISK})^T \end{aligned}$$

A3 Adding volatility

When applying volatility figures to the model the use of an accumulated volatility provides an expected volatility over time T.

$$\sigma^2 * T = \sigma\sqrt{T}$$

Adding this accumulated volatility to the returns of the model would give the following formulas

ISK

$$V_T = V_0 * ((1+r)^T \pm \sigma\sqrt{T}) * (1 - T_{ISK})^T$$

Capital gains account

$$V_T = V_0 * ((1+r)^T \pm \sigma\sqrt{T}) * \left((1-d) + d * (1-T_c)\right)^{T-1} * (1-T_c) + V_0 * T_c + V_0 * d$$
$$* (1-T_c) * \sum_{i=1}^{T} (\left((1-d) + d * (1-T_c)\right)^{t-1} * ((1+r)^t \pm \sigma\sqrt{T}))$$

A4 Changing the SLR

To be able to calculate the effect of the change in SLR over time we do

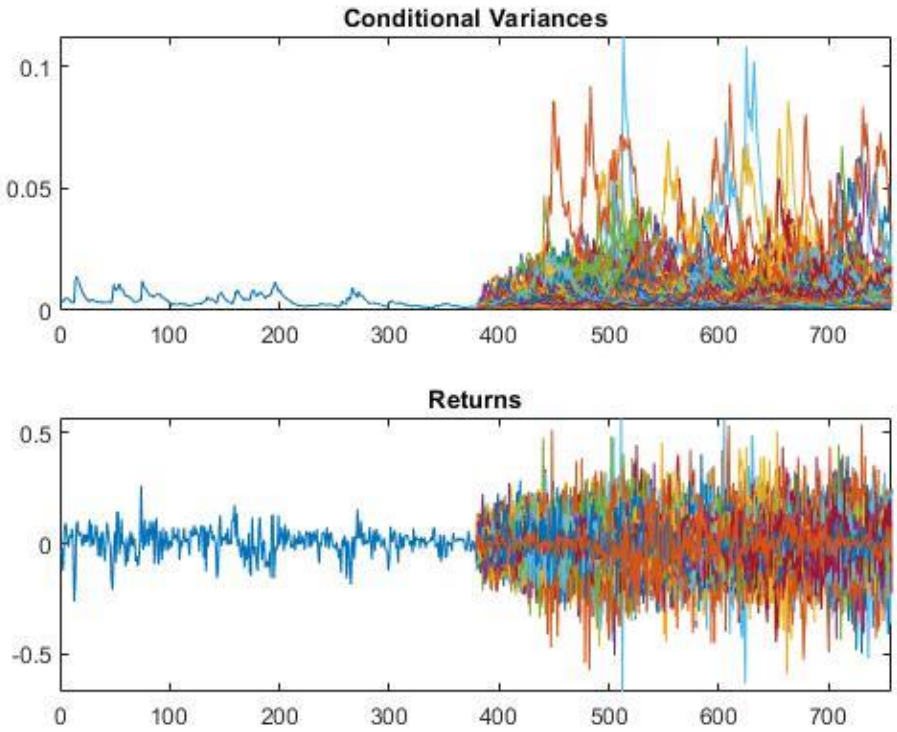
$$T_{ISK} = T_c * max(lowest\ allowed\ SLR; (SLR + fixed\ increase))$$

$$\left(1 - T_c * max\left(lowest\ allowed\ SLR; (SLR + fixed\ increase \pm variable\ increase)\right)\right)$$
$$* \left(1 - T_c * max\left(lowest\ allowed\ SLR; (SLR + fixed\ increase \pm 2 * variable\ increase)\right)\right) [\ldots]$$
$$* \left(1 - T_c * max\left(lowest\ allowed\ SLR; (SLR + fixed\ increase \pm (T-1) * variable\ increase)\right)\right)$$
$$* \left(1 - T_c * max\left(lowest\ allowed\ SLR; (SLR + fixed\ increase \pm T * variable\ increase)\right)\right)$$
$$= \prod_{i=1}^{T} \left(1 - T_c * max\left(lowest\ allowed\ SLR; (SLR + fixed\ increase \pm t * variable\ increase)\right)\right)$$

$$V_T = V_0 * (1 + r)^T * \prod_{i=1}^{T} \left(1 - T_c * max\left(lowest\ allowed\ SLR; \left(SLR + fixed\ increase \pm t * variable\ increase\right)\right)\right)$$

10.2 Appendix B Volatility

Figure B1 Conditional variances and Returns



MATLAB. Future conditional variances according to our GARCH(1,1) model alongside future returns. Future returns were illustrated to emphasis the uncertainty.

Equation B1

$$\sigma^2{}_t = \omega + \alpha \times \varepsilon^2{}_{t-1} + \beta\sigma^2{}_{t-1}$$

$$\text{Where } \varepsilon_t : I_{t-1} \sim N(0, \sigma^2{}_t)$$

$$r_t = c + Q \times r_{t-1} + \varepsilon_t$$

Bollerslevs GARCH. Its behavior is dictated by the following equation regarding the conditional variance equation. Epsilon measures any form of shock that the market is subjected to. The conditional mean equation above takes into account should the mean somehow be autocorrelated. Where $\bar{\sigma}^2$ is the variance, ω is the model constant, β is the GARCH term and α is the ARCH term.

$$\omega > 0, \alpha \geq 0, \beta \geq 0, \alpha + \beta < 1$$

Equation B2

$$\bar{\sigma}^2 = \frac{\omega}{1-(\alpha+\beta)}$$

Equation B3

$$\ln(\sigma^2{}_t) = \omega + g(z_{t-1}) + \beta \times \ln(\sigma^2{}_{t-1})$$

$$r_t = c + \sigma_t \times z_t$$

$$\varepsilon_t = z_t \times \sigma_t$$

where $Z_t \sim N(0,1)$

Nelson´s EGARCH function. A type of asymmetric GARCH function. Enables negative parameters since the ln function of variance will always be positive. Negative returns to the market results in a higher increase in volatility than a positive return. This is captured in the leverage effect, described in our thesis

Equation B4

$$\bar{\sigma}^2 = \exp\left(\frac{\omega}{1-\beta}\right)$$

Where $\bar{\sigma}^2$ is the variance, ω is the model constant, β is the GARCH term.

Table B1 GARCH normal distribution

GARCH(1,1) Conditional Variance Model (Gaussian Distribution)
Effective Sample Size: 378
Number of Estimated Parameters: 3
LogLikelihood: 532.777
AIC: -1059.55
BIC: -1047.75

	Value	Standard Error	TStatistic	PValue
Constant	0.00011704	6.836e-05	1.7121	0.086884
GARCH{1}	0.84769	0.037889	22.373	7.2494e-111
ARCH {1}	0.12824	0.034996	3.6643	0.00024802

Table B2 GARCH Student t distribution

GARCH(1,1) Conditional Variance Model (t Distribution)

Effective Sample Size: 378
Number of Estimated Parameters: 3
LogLikelihood: 541.519
AIC: -1077.04
BIC: -1065.23

	Value	Standard Error	TStatistic	PValue
Constant	0.00017366	0.00012218	1.4213	0.15522
GARCH{1}	0.81542	0.060511	13.476	2.1745e-41
ARCH {1}	0.16372	0.058692	2.7895	0.0052792
DoF	5	0	Inf	0

Table B3 EGARCH normal distribution

EGARCH(1,1) Conditional Variance Model (Gaussian Distribution)
Effective Sample Size: 378
Number of Estimated Parameters: 4
LogLikelihood: 536.682
AIC: -1065.36
BIC: -1049.62

	Value	Standard Error	TStatistic	PValue
Constant	-0.34747	0.15283	-2.2735	0.022997
GARCH{1}	0.93581	0.027516	34.009	1.6212e-253
ARCH {1}	0.24345	0.059951	4.0609	4.8888e-05
Leverage	-0.078883	0.024089	-3.2	0.001058

Table B4 EGARCH Student t distribution

EGARCH(1,1) Conditional Variance Model (t Distribution)
Effective Sample Size: 378
Number of Estimated Parameters: 4
LogLikelihood: 544.415
AIC: -1080.83
BIC: -1065.09

	Value	Standard Error	TStatistic	PValue
Constant	-0.72652	0.32266	-2.2517	0.024341
GARCH{1}	0.86706	0.058562	14.806	1.3416e-49
ARCH {1}	0.33412	0.10104	3.3068	0.0009437
Leverage	-0.14396	0.059308	-2.4272	0.015214
DoF	5	0	Inf	0

10.3 Appendix C Analysis

Table C1 Determining equal profitability – return and years

		Return	
1	-	7.11%	+
5	-	7.99%	+
10	-	9.80%	+
20		N/A	
30		N/A	
40		N/A	
50		N/A	

Table showing the corresponding returns for which the ISK and capital gains accounts are equally profitable over different time periods, as well as indications to which account type is more profitable for higher and lower rate of returns. For N/A, there is no rate of return where the ISK account is more profitable than the capital gains account.

Table C2 Determining equal profitability – years and return

		Years	
2%		N/A	
4%		N/A	
6%		N/A	
8%	+	5.05	-
10%	+	10.37	-
12%	+	13.14	-
14%	+	14.73	-

Table showing the corresponding time periods for which the ISK and capital gains account are equally profitable over different rates of return, as well as indications to which account type is more profitable for longer and shorter time periods. For N/A, there is no point in time when the ISK account is more profitable than the capital gains account.

Table C3 Determining equal profitability – capital gains tax and years

	Less	Capital gains tax	More
1	+	N/A	+
5	-	29.84%	+
10	-	73.01%	+
20	-	90.59%	+
30	-	95.51%	+
40	-	97.67%	+
50	-	98.75%	+

Table showing the corresponding capital gains tax levels for which the ISK and capital gains accounts are equally profitable over different time periods, as well as indications to which account type is more profitable for higher and lower yields. For N/A, there is no point in time, when the capital gains account is more profitable than the ISK account. Note that for all years the account are equally profitable at 0% capital gains tax. That is omitted from above.

Table C4 Determining equal profitability – years and capital gains tax

	Less	Years	More
5%	+	4.05	-
10%	+	4.20	-
15%	+	4.37	-
20%	+	4.56	-
25%	+	4.77	-
30%	+	5.01	-

Table showing the corresponding time periods for which the ISK and capital gains account are equally profitable over different capital gains tax levels, as well as indications to which account type is more profitable for longer and shorter time periods.

Table C5 Determining equal profitability – ISK and SLR

	Less	ISK/SLR		More
1	+	2.21%	6%	-
5	+	1.99%	5.63%	-
10	+	1.94%	5.46%	-
20	+	1.33%	3.43%	-
30	+	1.04%	2.47%	-
40	+	0.84%	1.8%	-
50	+	0.69%	1.3%	-

Table showing the corresponding ISK and SLR rates for which the ISK and capital gains accounts are equally profitable over different time periods, as well as indications to which account type is more profitable for higher and lower rates.

Table C6 Determining equal profitability – years and SLR

		Years	
0%	+	94.86	-
2%	+	36.66	-
4%	+	15.50	-
6%	+	3.06	-
8%		N/A	
10%		N/A	
12%		N/A	

Table showing the corresponding time periods for which the ISK and capital gains account are equally profitable over different SLR rates, as well as indications to which account type is more profitable for longer and shorter time periods. For N/A, there is no point in time, when the ISK account is more profitable than the capital gains account.

Table C7 Determining equal profitability – volatility and years

+ vol		Volatility	
1	+	N/A	+
5	+	N/A	+
10	-	12.37%	+
20	-	N/A	-
30	-	N/A	-
40	-	N/A	-
50	-	N/A	-

-vol		Volatility	
1	+	0.88%	-
5	+	0.00%	-
10	-	N/A	-
20	-	318.34%	+
30	-	218.97%	+
40	-	360.99%	+
50	-	672.92%	+

Table showing the corresponding volatilities for which the ISK and capital gains accounts are equally profitable over different time periods, as well as indications to which account type is more profitable for higher and lower volatilities. For N/A, there is no level of volatility for which the ISK account is more profitable than the capital gains account.

Table C8 Determining equal profitability – years and volatility

+vol		Years	
0%	+	5.01	-
10%	+	9.52	-
20%	+	11.13	-
30%	+	12.11	-
40%	+	≈12.75*	-

*Graphical approximation due to lack of computational power.

-vol		Years	
0%	+	5.01	-
10%	-	N/A	-
20%	-	N/A	-
30%	-	N/A	-
40%	-	N/A	-

Table showing the corresponding time periods for which the ISK and capital gains account are equally profitable over different levels of volatility, as well as indications to which account type is more profitable for longer and shorter time periods. For N/A, there is no point in time, when the ISK account is more profitable than the capital gains account.