

Introduction of the Swedish Investment Saving Account and Individual Stock Investment Behavior

Yao Fu (40783)

Abstract: The Swedish government introduced a new saving platform named as the Swedish Investment Saving Account (ISK) in January 2012 in order to simplify the taxation on the capital income of security investment. Compared to the conventional accounts (CA), ISK is taxed at a flat-rate based on the balance in the account, and there is no other taxation related to security sales and dividend distribution. To inspect the impact of the establishment of ISK on individual stock investment behavior and preference, this paper conducts a scenario analysis using based on Geometric Brownian motion model. The simulation results suggest the superiority of ISK account in a short investment horizon setup and indicate a positive relationship between stock systematic and idiosyncratic risks and the after-tax expected returns of ISK in comparison with that in CA. The paper further elaborates on the impacts of stock risks and individual investor characteristics on the investment preference of ISK by running empirical analysis on the sample of dividend-paying stocks. The regression results confirm the positive relationship between stock systematic and idiosyncratic risks and the percentage of shares invested in ISK as indicated in the simulations. Additionally, it could be inferred that young and male investors are more inclined to invest in ISK compared to other investors.

Keywords: capital income taxation, ISK, stock investment, idiosyncratic risk, systematic risk

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Supervisor:	Kelly Ragan, Paolo Sodini
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Discussant:	Alice Hindersson
Examiner:	Karl Wärneryd

Contents

1	Introduction	1
2	ISK and Stock investment in Sweden	3
2.1	Stock investment accounts in Sweden	3
2.2	Stock trading markets in Sweden and ISK	3
3	Taxation on Security Investment	4
3.1	Conventional account taxation	4
3.1.1	Capital gains and losses	4
3.1.2	Calculation of purchase cost	5
3.2	Investment saving account(ISK) taxation	5
3.3	Major difference between CA and ISK	7
3.4	Taxation of security investment around ISK introduction	8
4	Literature Review	8
4.1	Capital income tax and investment	8
4.2	Individual investment behaviors	10
4.3	Participation rate	11
4.4	Trading frequency and holding horizon	12
4.5	Portfolio diversification and idiosyncratic risk	12
5	Data	13
5.1	Euroclear Sweden data	13
5.2	Statistics Sweden data	14
5.2.1	Tax data	14
5.2.2	Income and Tax Register	14
5.2.3	Total Population Register	15
5.3	Finbas data	15
5.4	Serrano data	15
6	Impact of ISK	15
6.1	The implications of ISK	15
6.1.1	Simplification of tax declaration	15
6.1.2	Facilitate financial instrument investment for private investors	16
6.1.3	Improve the efficiency of financial resource distribution	16
6.2	Market effects	16
6.2.1	Trading volume	16
6.2.2	Market indices and number of stocks	17
6.3	Individual investor effects	19
6.3.1	Individual investor market value	19
6.3.2	Individual investor structure	20
7	Scenario Analysis	21
7.1	Simulation setup	21
7.1.1	Geometric Brownian Motion model for stock price	22
7.1.2	CAPM	23
7.1.3	Simulation steps	23
7.2	Scenarios for post-tax returns	24
7.3	Parameters	25

7.4	Simulation results	26
8	Empirical Analysis	28
8.1	Empirical sample and ISK share imputation	28
8.2	Regression at ISIN level	31
9	Conclusion	34
	References	36
	Appendix	38
A	Glossary	38
B	Example of CA Taxation	39
B.1	Example of purchase cost calculation using the average method	39
B.2	Example of capital gain and loss taxation	39
B.2.1	Capital gain taxation	40
B.2.2	Capital loss taxation	40
B.2.3	Capital loss taxation with upper limit	40
C	Other Simulation Results	40

List of Figures

1	Average daily traded volume by month	17
2	Swedish stock market indices	18
3	Number of ISINs	18
4	Total market value and summary statistics of market value per individual investor	19
5	Number of Swedish individual investors	20
6	Percentage of market value and owners, by the number of stocks owned	21
7	Return vs beta, horizon = 1 year	26
8	Return vs beta, horizon = 10 years	27
9	Imputed ISK shares and owners ratio	30
10	Return vs beta, horizon = 2 years	41
11	Return vs beta, horizon = 5 years	41
12	Return vs sigma, horizon = 1 year	42
13	Return vs sigma, horizon = 2 years	42
14	Return vs sigma, horizon = 5 years	43
15	Return vs sigma, horizon = 10 years	43

List of Tables

1	ISK summary statistics	1
2	Government borrowing rate and ISK standard interest rate	6
3	Amount of security investment tax and number of taxpayers	9
4	Simulation parameters	25
5	Dividend-paying stocks	29
6	Number of owners of dividend-paying stocks	31
7	Regressions of ISK shares % at ISIN level	33

1 Introduction

The Investment Saving Account (ISK) is an investment account introduced to Swedish individual investors in January 2012. The purpose of this new account is to simplify the tax declaration process for individual investors and promote investment in stocks and other financial instruments (Finansdepartementet, 2010). Unlike securities in the conventional account (CA), securities held in ISK are taxed at a flat rate and there is no need for investors to report capital gains and losses.

The primary inducement for the establishment of ISK is the complexity of individual taxation declaration on capital income related to security investments. The limited ability and insufficient financial education impede individual investors from filling out the declaration forms, which may require complicated calculations of purchase costs considering historical corporate actions and multiple transactions, correctly.

According to the Swedish National Audit Office (Riksrevisionen, 2018), the Sweden Tax Agency conducted several surveys and random checks concerning tax errors during the beginning of the 2000s. One of the surveys reported that 33% of individuals that sold listed stocks in the income year 2001 made mistakes in the tax declaration. In one internal report in 2014¹, the Swedish Tax Agency summarized the results of random checks it carried out during 2005-2008, including the declaration of stock sales. The proportion of investors who made accounting mistakes in the declaration was 58% in 2006, 53% in 2007, and 61% in 2008, and most of the errors were related to the calculation of purchase costs.

Due to its simplicity by nature, ISK has gained great popularity among Swedish investors within several years after its introduction. As stated in Table 1, the number of individuals with ISK accounts had mounted from 0.2 million in 2012 to 1.8 million in 2016², almost the same as the number of individuals that own shares in Swedish companies by the end of 2016³. As an approximation to the total value in ISK, the total value of the capital base in ISK amounted to around 545 billion SEK in 2016⁴, whereas the total market value of Swedish companies listed on the Swedish market and held by Swedish private investors was around 600 billion SEK⁵.

Table 1: ISK summary statistics

Year	2012	2013	2014	2015	2016
Number of Holders	210,626	453,396	786,952	1,477,402	1,803,236
Standard Rate (%)	1.65	1.49	2.09	0.90	1.40
Capital Base	43.53	135.86	261.15	438.30	545.04
Standard Income	0.72	2.02	5.46	3.94	7.63
Tax Revenue	0.22	0.61	1.64	1.18	2.29

Notes: Capital Base, Standard Income, and Tax Revenue are valued in billion SEK. Data from IoT.

¹Skatteverket, Analys Värdepappershandel, 2014-05-23. Cited in “Investeringssparkonto – en enkel sparform i ett komplex skattesystem (RiR 2018:19)”.

²Estimated based on the number of individuals with positive standard interest income in ISK. Data from IoT register at Statistics Sweden.

³Euroclear Sweden

⁴Data from IoT register at Statistics Sweden, with own calculation.

⁵Euroclear Sweden and Finbas, with own calculation

Even though the success of the ISK is irrefutable from the perspective of acceptance among individual investors, the comprehensive advantages of ISK compared to CA are ambiguous in the long horizon and out of the scope of tax efficiency. It has been discussed that ISK might not always be tax-beneficial for investors, especially when the market declines as capital losses in ISK are not tax deductible. Thus, the investment in ISK might bear more risks compared to CA.

Similarly to ISK in Sweden, there are equivalent products in effect during recent years in other EU countries. Finnish parliament accepted the proposal and impose Equity Saving Account (ESA) in Finland on March 13, 2019 and the account was opened to investors in January 2020. According to Riihimäki (2019), there were three major factors that contributed to the establishment of this saving account in Finland. The first is the low-interest rate trend worldwide after quantitative easing from the 2008 crisis. Bank deposit which was the most popular choice among Finnish households regarding savings became profitless under this context, and private individuals were seeking alternatives for saving and investment. Secondly, the participation rate of retail investors in the stock market was quite low in Finland. Encouraging more retail investors and attracting additional investment made to the capital market was one of the economic policy targets. Thirdly, the taxation declaration procedure was complex for ordinary people. In general, the Finnish authority intended to simplify the taxation on capital income and encourage prospective individual investors to participate in the capital market.

Norway introduced a savings account in the fall of 2017 with the name “aksjesparekonto” (ASK). Norwegian investors could put stocks and mutual funds in the account (Nguyen and Skartland, 2019). The account is tax-free but with restrictions. The stocks bought with the account savings must be listed in the EU or Norway. And the mutual funds must include 80 percent of stocks listed in the EU or European economic region. The taxation on capital income is tax-deferred which means the gain tax is levied only when investors withdraw the money from ASK.

The United Kingdom also introduced a corresponding product called Individual Saving Account (ISA) in 1999. In this account, individuals are enabled to invest money in stocks with an upper limit and are exempt from any taxation related to capital income and dividends. As mentioned in Adam and Jonathan (2016), ISA is quite popular in the UK and one-third of its population joined the account.

Based on the current research, this paper aims to analyze the macro and micro impacts of ISK on stock investment in Sweden and the behavior of individual investors both in the short-term and in the long-term, when the economic situation might alter. Taking advantage of the micro data, this paper further investigates the characteristics of stocks favored by individual investors with ISK as an alternative investment channel in addition to the conventional investment accounts bearing capital gains taxation.

2 ISK and Stock investment in Sweden

2.1 Stock investment accounts in Sweden

There are different channels for individuals to invest in stocks and shares in Sweden. Before the introduction of ISK in 2012, the Direct Securities Account (VP-konto) and Custody Account (depå) are two common ways to invest in securities. The former is categorized as directly-registered account and the latter is indirectly-registered account according to Euroclear Sweden. The main difference is that private investors are registered as the owners at the company they own shares in the direct investment account. Contrastingly, in the custody account, even though investors are still the real owners of their shares, financial institutions that distribute shares such as banks and stock brokers are regarded as owners from the point of view of companies instead and will receive notice of general meetings and new issues directly. In the paper, the term “conventional account (CA)” denotes both of these two types of accounts, as they are taxed analogously.

By definition, ISK also belongs to indirectly-registered account, as individuals need to open ISK through financial institutions such as banks. The range of shares that could be invested in ISK is limited and narrower than that of conventional accounts, this is further explained in section 2.2.

In addition to these security investment accounts above, it is also possible to invest securities through capital insurance (kapitalförsäkring) and IPS (Individual Pension Savings account). However, the scheme of capital insurance is more similar to insurance by nature. The stocks held in capital insurance accounts are administrated by the insurance companies and investors are not registered as the owners of their shares. The capital insurance also usually has certain commitments period thus being less flexible. The Individual Pensions Savings account used to be a popular way of securities saving with deferred taxation similar to most pension accounts, but it has been less financially attractive after its tax deduction was reduced in 2016 and it is now only favorable for a minority of people as a supplement to the occupational pension.

2.2 Stock trading markets in Sweden and ISK

In principle, the Investment Savings Account is intended for keeping investment assets. By definition, investment assets include financial instruments listed on regulated markets or equivalent markets, financial instruments traded on an MTF trading platform within EEA areas, mutual funds and special funds, and cash (Finansdepartementet, 2017).

In Sweden, there are two regulated markets (stock exchanges) for stock trading, Nasdaq Stockholm (Stockholmsbörsen) and Nordic Growth Market (NGM Main). MTF stands for multilateral trading facility, which are alternative trading markets with lower requirements on the companies compared to stock exchanges. The three major MTFs in Sweden are First North operated by Nasdaq, NGM Nordic MTF operated by Nordic Growth Market, and Spotlight, which was previously named Aktietorget. Conceptually, a company’s share shall only be addressed as “listed” when it is traded on the stock exchanges. However, it is common to use

the term "listed" for shares traded on MTFs in daily life.

In addition to these investment assets, individuals may also transfer and keep non-investment (non-account) assets in their Investment Savings Accounts for a limited time period. Assets that are not investment assets are considered non-investment assets, such as unlisted shares.

This demarcation brings complexity to scenarios such as dividend issues and IPOs for investors. For instance, when a company distributes shares in an unlisted subsidiary, the shares would be treated as non-investment assets and could only be kept in the Investment Savings Account for a short period of time. And if the new shares are first purchased in the conventional account and transferred to Investment Savings Account after listing due to this limitation, extra capital income tax expenses might incur since transferring assets from the conventional account to the Investment Savings Account is considered as shares sales.

3 Taxation on Security Investment

The taxation of foreign stocks may differ slightly from Swedish stocks depending on the type of investment account. The discussion in this paper mainly focuses on the Swedish stocks held by Swedish residents.

3.1 Conventional account taxation

3.1.1 Capital gains and losses

For listed stocks held in conventional accounts, taxation declaration incurs only upon sales of the shares. It could be either tax credits or tax deductions depending on the magnitude of capital gains and losses and the type of securities. Capital gains from selling stocks may entitle 30% of capital income tax. The dividends of stocks in conventional accounts are also considered capital income, but for most investors, this would not bring additional work for tax declaration, as dividends are usually already subtracted for 30% of capital income tax before being distributed to the investors and this source of capital income is normally auto-filled on the income declaration form.

In conventional accounts, capital gains may be offset by capital losses. Individuals are required to report all categories of realized capital gains and losses in their income tax declaration form every year. If the net total amount under capital income is negative, one would be entitled to at most 30% of tax deduction from the capital loss. This deduction could be combined with taxes from other types of income including earned income and business activity income in the same income year, and could not be deferred or transferred to another individual. When the capital loss is greater than 100,000 SEK, the tax deduction would be 21% of the excess amount.

It is worth noting that even though capital incomes are generally reported to calculate tax credits and tax deductions, the percentages of capital gains and losses to be considered for taxation could differentiate by

the category of capital income. Even for the same category of capital income, the tax-bearing percentage for gains and losses might differ. Only 70% of total capital losses from selling listed stocks could be tax-deductible. In Appendix B.2, I further listed several examples of capital gains and losses taxations in CA in detail.

3.1.2 Calculation of purchase cost

It is the stock owners' responsibility to declare capital gains and losses to the tax agency when selling stocks. The investors are only embedded with tax-declaration assistance in connection with the net revenue from sales because financial institutions are obliged to report to the Swedish Tax Agency regarding private investors' net earnings from sales after subtracting brokerage and transaction costs. In order to calculate the value of capital gains and losses, individuals may also need to take all corporate actions and transaction history records during the entire holding period into consideration, calculating the average purchase costs, which could be extremely complex.

The Swedish Tax Agency offers two methods for calculating the stock purchase cost, the average method, and the flat-rate method.⁶ As indicated in the name, the average method requires the investors to calculate an average purchase cost per share. This could be complicated because the stocks might be bought and sold multiple times at different prices, and corporate actions such as share splitting would cause a change in the purchase cost per share. It may be considerably challenging for those with limited knowledge of financial literacy and/or who didn't keep a complete record of history purchases and sales. A detailed example of calculating purchase cost using the average method is discussed in Appendix B.1. On the other hand, the flat-rate method is relatively simple as it allows investors to report purchase costs as 20% of the net revenue from sales. However, this method would only be tax-favored if the price of the stock upon sale is more than 4 times the purchase price, thus would be avoided by individuals on most occasions.

As discussed in section 1, these self-reported values could be quite imprecise and most of the mistakes in the tax declaration related to security sales are indeed caused by miscalculations of the purchase cost.

3.2 Investment saving account(ISK) taxation

The new ISK is taxed at a flat rate. Individual investors need to pay capital income tax based on the standard revenue estimated from the total amount of assets in the account, and there is no extra taxation related to the actual realized capital gains and losses anymore.

Additionally, when an individual transfers assets from the conventional account to ISK, it would be regarded as selling from the conventional account and a new deposit is then made to the ISK. Thus, there might be a tax credit or deduction incurred depending on the capital gain or capital loss from the conventional account in addition to the taxation for the new deposit in ISK in the event of account transfer.

⁶SKV 332 utgåva 18, Försäljning av värdepapper, Skatteverket 2017.

Table 2: Government borrowing rate and ISK standard interest rate

Income Year	Government Borrowing Rate	ISK Standard Rate
2012	1.65	1.65
2013	1.49	1.49
2014	2.09	2.09
2015	0.90	0.90
2016	0.65	1.40
2017	0.27	1.25
2018	0.49	1.49
2019	0.51	1.51
2020	-0.09	1.25
2021	-0.1	1.25
2022	0.23	1.25
2023	1.94	2.94*

Notes: The government borrowing rate is taken from the end of November one year before the income year according to the Tax Agency's regulation. (*) The ISK standard interest rate in income year 2023 is estimated as 1% plus the government borrowing rate in 2021 November, assuming the rule is unchanged compared to income year 2022.

Similar to other categories of capital income, the standard revenue from ISK is taxed at 30%. The standard revenue is calculated as the product of the capital base in ISK multiplied by the standard interest rate, where the capital base is an evaluation of capital held in the Investment Savings Account during the year, calculated as a quarter of the total market value of several components. These components consist of the value of assets kept in ISK at the beginning of each quarter, and the deposits into ISK during the year to prevent tax avoidance by transferring money out of ISK before the balance check in each period.

The standard interest rate could be considered as the approximate return rate in ISK set at a relatively low level. When ISK was introduced, it was initially set as the government borrowing interest rate by November 30 the year before the income year, which is a reference rate reflecting the risk-free long-term market rate. But it has been raised several times due to the low-interest rate since 2015.

Table 2 shows the series of ISK standard interest rate and the according government borrowing rates used for tax calculation. In 2016, the standard rate was raised to the government loan rate plus 0.75 percentage points, with a newly-established minimum limitation of 1.25 percentage. The standard rate was raised further in 2018, to the government loan rate plus 1 percentage point.

Thus, the taxation value T_{ISK} of ISK account could be expressed as below:

$$T_{ISK} = \tau r_s \frac{1}{4} (N_y + \sum_{n=1}^4 Q_n)$$

In the above equation, N_y denotes the aggregated capital deposit made to the ISK, Q_n represents the total value in ISK measured at the beginning of each quarter. r_s is the standard interest rate and τ is the capital income tax rate which should be 30%.

Based on this equation, it could be deduced that ISK taxation is determined by three key variants, they are N_y , Q_q , and r_s . Obviously, N_q reflects the extent of attraction and recognition of ISK. The more attractive the new account (ISK), the more capital would be transmitted to it. And Q_q is predominantly depending on both the portfolio performance and the value of the deposit and withdrawal of the account.

3.3 Major difference between CA and ISK

The conventional account is still in practice and accessible when ISK was introduced. It is left to the investors to make the decision about whether to open ISK or not and how to allocate capital between different financial instruments and various types of accounts.

In general, the main difference between ISK and CA lies in tax declaration. Sweden's conventional investment account is a capital gain realization taxation system. It means the taxes are levied only when investors sell assets and realize gains. Meanwhile, the losses could be deducted to offset the overall gains when taxes are applied. Capital gain tax liability is incurred upon the sale of the asset or payment of dividends. In contrast to the conventional account, tax is levied with a flat rate with ISK, which means it is a non-gain related taxation scheme. The approximate tax-bearing capital income of ISK is standard interest income, which is estimated from the capital base determined by quarterly asset market value and net yearly capital inflow to the account.

According to the ISK mechanism, the taxation rate on capital base would be calculated based on the Swedish government borrowing rate. That means the government borrowing rate acts as the key variable to determine the tax amount levied on investors. However, the government may implement adjustments on the ISK standard revenue rate by either adding or subtracting certain percentages to the government borrowing rate to keep fiscal neutrality stable between different forms of savings. As discussed above and shown in Table 2, such circumstances have occurred twice since ISK's introduction. In 2015 February, Sweden's central bank Riksbank, started a quantitative easing policy by purchasing government bonds and introducing a negative policy rate. This explains why the incremental amount of ISK standard interest rate compared to the government borrowing rate has been raised several times since then. On the other hand, Table 2 also indicates that the estimated ISK standard interest rate in 2023 would reach the highest level since its introduction following the hiked interest rate as an attempt to smooth inflation, which would in turn enlarge the tax expense of holding an ISK for investors.

On this basis, it is worthwhile to stress the differentiation of CA and ISK on capital losses. One beneficial aspect of investing in the conventional account is that the capital losses could be partially offset by tax deduction, whereas in ISK investors need to bear 100% the losses from unprofitable investments. Under the context of an extremely high-interest rate, the stock performance might be negatively affected and lead to capital losses, while the investors might still be faced with high tax expenses from ISK due to raised standard interest rate. From this perspective, ISK would aggravate after-tax return fluctuation for investors

and increase the risk level of investments.

3.4 Taxation of security investment around ISK introduction

From the discussions above, it would be interesting to inspect the total amount of taxation levied related to security investment and the number of corresponding individual taxpayers. Table 3 shows the summary statistics of aggregated taxation for several major types of securities during 2008-2015. From this table, one could notice that the taxation amount from sales of listed stocks are increasing since 2011 while the number of taxpayers is slightly shrinking. This might be explained by the increasing market activity level during that period, or it could be reflecting the transitional effect when people move investments from conventional accounts to ISK. On the other hand, the stock dividends tax increased slowly since 2012 whereas the number of taxpayers showed a declining trend. This implies the majority of dividend-paying stocks owner stuck to the conventional account, but they might steadily move into ISK or use ISK as a supplementary channel.

When focusing on ISK-related taxation, we could see that its magnitude is much lower compared to taxation from the conventional account. However, the number of participants with ISK accounts has already caught up the numbers of people selling stocks or holding dividend-paying stocks in 2015. This verifies the tax superiority of the ISK during the initial years after its introduction, and that ISK may impose a positive impact on stimulating individuals' investment in the stock market.

4 Literature Review

4.1 Capital income tax and investment

Taxation is always a prominent topic both for individual investors and policy-makers. It is well known that tax revenue functions as the basis of fiscal policy in supporting government operations and the government would thus be inclined to maximize the tax revenue in a theocratic world. The introduction of ISK brought a significant simplification to individual capital income taxation, it also changed the timing of taxation from at the time of sales based on realized capital income to yearly taxation based on account balance. Since the relationship between investment decisions and capital taxation could be complex, it is worthwhile to elaborate on research related to capital income taxation and investment.

According to Jones et al. (1997), the optimal tax rate on capital income should be zero whereas the tax rate on labor income is positive in the long term. Theoretically, the investor should be taxed on capital income due to their saving preference (Goloso et al., 2013).

Before ISK was introduced, capital investment in Sweden was mostly taxed by the realized gains. This kind of tax convention is also common in many other countries. The capital income tax is levied only when the gain is liquidated. Meanwhile, the capital losses could also be tax-deductable. Investors would then

Table 3: Amount of security investment tax and number of taxpayers

	2008	2009	2010	2011	2012	2013	2014	2015
<i>Taxation Amount (Billion SEK)</i>								
Dividends of securities ⁱ	9.15	8.09	6.75	7.42	8.16	5.48	5.86	7.08
Dividends of stocks ⁱⁱ	5.89	4.21	4.35	4.77	4.64	4.48	4.74	5.14
Dividends of Swedish shares ⁱⁱⁱ	5.88	4.15	4.29	4.80	4.65	4.55	4.79	5.10
Capital income from sales of listed stock, etc. ^{iv}	0.07	1.99	4.02	1.45	2.18	4.69	6.28	8.43
Capital income from sales of funds	0.03	0.02	-0.13	0.04	0.02	0.02	0.04	0.08
Standard income of funds in holding ^v	.	.	.	.	0.01	0.01	0.01	0.01
Standard interest income of ISK	.	.	.	.	0.22	0.61	1.64	1.18
<i>Number of Individuals Paying Tax (Million)</i>								
Dividends of securities	4.36	4.27	4.17	4.24	4.18	1.60	1.53	1.48
Dividends of stocks	1.78	1.47	1.55	1.68	1.63	1.54	1.48	1.42
Dividends of Swedish shares	1.74	1.42	1.50	1.65	1.60	1.52	1.45	1.39
Capital income from sales of listed stock, etc.	0.97	0.91	0.97	0.94	0.84	0.55	0.84	0.82
Capital income from sales of funds	0.08	0.07	0.07	0.21	0.14	0.09	0.09	0.14
Funds outside ISK	.	.	.	.	4.11	4.00	3.91	3.84
ISK	.	.	.	.	0.21	0.45	0.79	1.48

Notes: This table used data from SCB's IoT register, tax data including KU31, KU32 and K4, Finbas database, Euroclear Sweden shareholder dataset, in combination with self-calculations.

(i) Types of securities that need to be declared in tax form KU31, including company shares, paid subscription shares, Swedish depository receipts (SDB), etc.

(ii) Stocks traded on Nordic Stock Exchanges, MTF's and OTC markets. ISINs found in the Finbas database.

(iii) Swedish company shares including shares that are not publicly traded or traded outside Nordic markets. ISINs found in Euroclear Sweden's shareholder dataset.

(iv) Types of securities that need to be declared according to tax form K4-A, including listed stocks, equity-linked notes, etc.

(v) Since 2012, funds held in conventional accounts outside ISK bear a flat-rate tax based on standard income, which is similar to the ISK standard interest income.

be able to optimize their taxation situations by choosing the timing of realizing the capital gains or losses. Constantinides (1984) conducted an investigation under such a tax regime. He concluded that investors had the incentive to sell assets with losses, which could be deducted from the gains. On the other hand, the investors would be reluctant to liquidate any gains that surpass the losses. In most cases, the investors would hold the asset as long as possible until forced realization. They would be motivated to defer realizing capital gains in favor of less taxation.

4.2 Individual investment behaviors

One commonly observed individual investors' behavior under the realized capital gain taxation scheme is the disposition effect. The disposition effect describes the propensity of investors to hold assets that have depreciated in value and sell assets that have increased in value. Many research has provided robust evidence of this type of investment behavior bias, including Oden (1998) and Genesove and Mayer (2001). Oden (1998) suggests that tax awareness may influence investor trading and mitigate the disposition effect. The existence of the disposition effect would impede rational pricing of stocks and trading turnover (Goetzmann and Massa, 2003).

Bazley et al. (2022) investigated trading behavior under different tax rate brackets among American states. There was no significant evidence found on trade behavior with time-invariant tax rates influence. However, when the three states remedied (reducing the tax rate for capital gain under certain circumstances) the tax scheme partially, they did find causal evidence proving that increased tax awareness could affect trading behavior and mitigate the disposition effect. This empirical research indicates that tax consequence awareness may affect trading behavior. The influence can be summarized in two dimensions, one is that it decreases investors' willingness to realize gains and the other is increasing the tendency to realize losses. A higher tax rate would thus discourage frequent trading which investors are prone to avoid trading costs.

Another key factor that impacts the disposition effect is the performance of the asset portfolio. The disposition effect might be strengthened when the portfolio is at a loss. Investors may be anxious to realize the limited return to avoid further deficits. The such type of portfolio-driven disposition effect is also confirmed by Barberis and Xiong (2009).

The impact of tax scheme transformation on investment behavior was reconfirmed by Neoclassical theory (Constantinides and Scholes, 1980). But the investment decisions made by investors could be heterogeneous and the empirical evidence could be mixed. Ivković et al. (2005) identified the lock-in effect by comparing trading behavior across taxable and non-taxable accounts. It indicated that the investors normally tend to defer the realization of gains in taxable accounts. But some researchers also suggested that the sensitivity to taxation only exists among sophisticated investors (Auerbach et al., 1998).

When the tax is levied yearly based on account balance with a flat rate as in ISK scheme, it would be

no longer profitable for investors to defer capital gains realization. It would undoubtedly affect investment strategies and trading behaviors. Nordström LÖf (2012) conducted a research on this subject to compare ISK with CA. They drew the conclusion that active investors would be more beneficial to invest in ISK. While the passive investment strategy with a longer horizon probably fits better in CA when time intervals between the transactions are relatively long. The investors would not need to pay any tax in CA for years before the liquidation if they follow the passive "buy and hold" principle.

Larsen and Hampus (2014) also explored on the comparison of ISK and CA but with a different methodology. They employed option theory with a dynamic programming approach to examine the tax effect caused by the introduction of ISK. They emphasized the importance of offering investors an alternative saving account rather than only comparing the features of the two schemes.

4.3 Participation rate

According to Haliassos and Bertaut (1995), there are four major factors contributing to the stock market participation rate, including household preferences, pecuniary and information costs, participation risks, and peers' influence. They explored the connection between expected utility, fixed costs, and participation rate. Other scholars contributed to related research from the aspects of disappointment aversion (Ang et al., 2005), loss aversion (Gomes, 2005), rank-dependent utility (Chapman and Polkovnichenko, 2009), etc.

Empirical analysis suggested that both explicit expenditure and implicit costs would inhibit households from investing in the capital market. The explicit expenditure could be the cost to open an account in an institution and future brokerage commission etc. Implicit costs might be more ambiguous and elusive, including investment advice and investment allocation strategy, especially for those savers who lack financial literacy (Gomes and Michaelides, 2005).

When individuals are strongly risk-averse, they would be reluctant to invest in risky assets. And labor income levels could also be related to stock market investment (Benzoni et al., 2007). Lacking trust, perceiving excessive risks, and expecting limited returns would also negatively affect individuals on participation (Guiso et al., 2008).

Equity market participation is a financial indicator reflecting the maturity and activity level of the financial market in addition to the diversification of household asset allocation. In many countries, the majority of the population does not hold any stocks. The proportion of people who own stock would be even lower if excluding the financial instruments in the pension scheme. This fact was well documented in the literature on the U.S. from Mankiw and Zeldes (1991) and Haliassos and Bertaut (1995). The articles from Guiso et al. (2002) also provide similar evidence in European countries.

In the above papers, the stock participation rates were all lower than 50%. When pension plans were included, this percentage in the U.S. was just below 50%. And when the asset in the defined-contribution retirement

account is excluded, this fraction dropped close to only 20% (Badarinza et al., 2016). This indicates that the increment of stock market participation could be largely driven by the defined-contribution pension scheme.

Additionally, individuals could be infected by their peers who are already in the stock market. The peers could be their co-workers or neighbors and the savers may join them on the stock investment due to social utility or imitation intention (Hong et al., 2004).

4.4 Trading frequency and holding horizon

The behavior of trading could be related to either gain realization or loss realization. The analysis from Ivković et al. (2005) indicates the holding period time follows an exponential distribution. It means that the selling probability decreases tremendously in the first months after purchase and the probability is relatively stable afterward. Due to the heterogeneity of investors in trading, it could be derived that the behavior of most investors may exhibit path dependence, which means some investors are more inclined to trade in high frequency and focus on short-swing trade while others may be favorable to long-investment-horizons.

Bazley et al. (2022) revealed that the disposition effect disappeared in December. The investors were most likely to pay more attention to tax implications and are in high probability to realize a loss in December to offset gain under the realization gain tax scheme. Oden (1998) also noted time variation in the disposition effect. He found the disposition effect declined significantly in December and investors realized losses in much higher frequency than those in other months. These results were based on the realized-gain taxation frame.

4.5 Portfolio diversification and idiosyncratic risk

Initiated by ICAPM in Merton (1973), plenty of scholars conducted abundant research on the topic of asset expected returns. It was found that there was a positive relationship between expected return and idiosyncratic risk when the portfolio is under-diversified. The trade-off between return and risk had been regarded as the basic rule in asset pricing theory. However, empirical studies also provide other evidence. Modern portfolio theory suggests that investors hold a portfolio of stocks to diversify idiosyncratic risk. The capital asset pricing model (CAPM) builds on the portfolio theory and predicts that all investors hold the market portfolio in equilibrium. As a result, only systematic risk is priced in equilibrium and idiosyncratic risk is not.

After examining the standard deviation of portfolio returns, Campbell (2001) suggested that “the number of randomly selected stocks needed to achieve relatively complete portfolio diversification” is about 50. It is rarely the case in real financial markets all over the world.

In reality, many investors in the stock market do not follow the rule of diversification due to either rational or irrational justifications. Barber and Odean (2000) conducted an investigation and reported on average one

household holds only 4.3 stocks whereas the median is 2.61 stocks. Many employees held the shares of the company where they are working with irrationally high proportions as shown in Benartzi and Thaler (2000). This indicates that investors are more likely to allocate their assets to familiar stocks without sufficient diversification.

Merton (1987), Malkiel and Xu (2003), and Levy (1978) extended the CAPM model to evaluate the relationship between asset pricing and market returns with idiosyncratic risk. Barberis and Huang (2023) also verified a positive relationship between expected return and idiosyncratic risk. And Lintner (1965) found that the residuals from a market model could well explain the average cross sections stock returns. The results was confirmed by Lehmann (1990). Goyal and Santa-Clara (2003) further discussed on idiosyncratic risk and found a positive relationship between idiosyncratic equity risk and return. Kausar et al. (2023) proposed the existence of the idiosyncratic risk puzzle with the empirical study on the stock markets of BRICS(Brazil, Russia, India, China, and South Africa). Their research emphasized the impact of arbitrage when explaining market performance.

5 Data

For the purpose of empirical analysis, this paper uses microdata compiled and scrambled by Statistics Sweden for a research project conducted by Paolo Sodini and Anastasia Girshina from the Department of Finance at the Stockholm School of Economics. My access to the data is granted as part of their research project. All identifiers of individual units such as the Swedish personal identity number (personnummer) for each individual have been enciphered into fake identifier numbers. And it is not possible to link the fake identifier with the original identifier.

5.1 Euroclear Sweden data

Euroclear Sweden is the Swedish Central Security Depository(CSD), formerly named VPC(värdepapperscentral). Euroclear Sweden maintains a shareholder dataset at ISIN level and a financial instrument list at the company level for all listed Swedish public limited companies.

The shareholder dataset contains the identifier of each shareholder, type of shareholder, number of shares in holding, ISIN code of assets in holding, type of account, and is available semi-annually 1999-2005 and quarterly 2006-2018.⁷ It includes ownership information of both listed shares and unlisted shares of companies, and only the share information of those shares listed on stock exchanges or traded on MTFs is used in this paper.

The financial instrument list contains the identifier of the company and the ISIN code of its issued financial

⁷The shareholder data at the end of 2013 September is missing due to data availability. Additionally, the shareholders from 2013 December to 2014 September is incomplete in the sense that indirectly-registered shares from individuals that hold less than 501 shares of a company were not included.

instruments registered at Euroclear Sweden. This data is available semi-annually 2001-2005 and quarterly 2006-2015, with gaps in between.

In the shareholder dataset, Euroclear Sweden has classified account types into several categories, and the two essential account types related to individual owners are owner account and nominee account. Unlike owner accounts, nominee accounts are held by financial intermediaries such as banks and stock brokers on behalf of owners such as private investors, and these nominees are obliged to report the detailed owner list and their corresponding shares to Euroclear Sweden. Thus, for individual investors, the owner account and nominee account with detailed owner information corresponds to the direct securities account and indirect account (custody account and ISK) as discussed in section 2.1.

It could be inferred that one should be able to observe the holdings of stocks at the individual level for shares in CA, IPS, and ISK. Since the insurance companies are the owners of capital insurance, we could not detect people who invest in their capital insurance in the Euroclear Sweden holding data.

5.2 Statistics Sweden data

5.2.1 Tax data

The tax data used in this paper is the yearly examination information data and individual income declaration data originally from the Swedish Tax Agency (Skatteverket). The examination information (Swedish kontrolluppgifter, KU) is the information that companies, banks, and other institutions are obliged to submit to the tax agency after each income year in order to assist private individuals with tax declaration. It includes dividends, sales of assets, etc.

KU31 is the examination information about dividends and other returns of assets such as stocks and funds.⁸ KU32 is the examination information about sales of financial assets, mainly stocks. It includes the number of shares sold, the sales value excluding commissions for each security, and the ISIN code of the security.

Only information about assets held in CA should be included in these examination information forms mentioned above, and assets in ISK and IPS should not be reported. These data are available yearly for all individuals obliged to pay income tax in Sweden during 1999-2015.

5.2.2 Income and Tax Register

The Income and Tax register includes yearly disposable income, labor income, and etc. of all taxable individuals during the income year and individuals registered in Sweden by the end of the year. Data is available 1999-2016.

Since 2012, the standard incomes from ISK and funds held in traditional security accounts are reported in the Income and Tax register as part of capital income.

⁸Before 2008, KU31 also includes the holdings of these assets for wealth taxation.

5.2.3 Total Population Register

The Total Population Register includes the demographic characteristics of individuals registered in Sweden by the end of the year. For example, age, civil status, gender, education level, household id, etc. Data is available 1999-2015.

5.3 Finbas data

Finbas is a comprehensive financial database with daily prices for major indices and stocks traded on Nordic stock exchanges and MTFs, offered by the Finance Research Data Center at the Swedish House of Finance. The time range spreads from as early as 1912 to the end of 2021. The daily stock prices are available both originally as the last price of the day and adjusted after adapting for corporate actions. The value per share and date of stock dividends are also included. This paper mainly uses price and dividend data of Swedish companies listed on stock exchanges and MTFs in Sweden.

5.4 Serrano data

Serrano Database contains the financial history and basic characteristics of Swedish companies. This database is also offered by the Finance Research Data Center at the Swedish House of Finance. This paper mainly used the Serrano for basic information of listed companies such as sectors.

6 Impact of ISK

6.1 The implications of ISK

6.1.1 Simplification of tax declaration

As discussed earlier, for most or at least some individual investors, it might be complicated to declare capital gains and losses from sales of financial assets correctly in conventional accounts. The conventional method of calculating purchase costs demands fundamental finance knowledge from investors to correctly incorporate the effect of corporate actions such as share splits and new emissions. In addition, individuals need to keep track of all the purchase and sales history of the stocks owned, which could be time-consuming and unfriendly to inexperienced investors. Thus, it is common for individuals to declare their capital income taxes from selling stocks incorrectly either intentionally or unintentionally. The taxation amount in ISK is calculated based on asset value with a given percentage and levied yearly. This is much less complicated compared with the conventional one.

6.1.2 Facilitate financial instrument investment for private investors

Under the scheme of CA taxation, amateur investors with limited financial knowledge need to deal with complex calculations for tax declarations. These existing obstacles are particularly unfriendly to the new participants in the stock market and may prevent them from actively trading on the market.

Since the introduction of ISK as a new method for saving in 2012, the values of capital and individuals registered under ISK have increased progressively during the initial years. In this context, ISK might be potentially viewed as a favored supplementary investment approach. It would be an interesting topic to further analyze investors' attitudes toward taxation simplification led by ISK and to what extent the individuals have reacted in the stock market.

6.1.3 Improve the efficiency of financial resource distribution

Since each sale of stocks in the CA may induce capital income tax, investors might be reluctant to redeem capital gains due to potential tax expenses and behave irrationally as affected by this lock-in effect. Thus, investors might be inclined to lower transaction frequency when capital gain tax upon sales is in place. This would induce lower turnover rates of financial assets and may negatively affect the financial market.

With ISK, individuals will be able to sell financial assets more freely without considering capital gain tax costs and the lock-in effect caused by conventional accounts might be eliminated. Therefore, the introduction of ISK may improve the efficiency of financial resource distribution and stipulate the competition of the stock market through the enhanced turnover of financial assets.

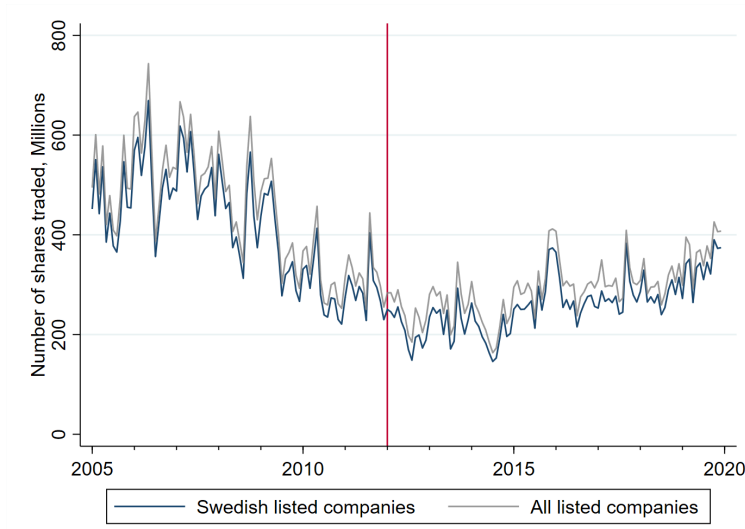
6.2 Market effects

As stated before, the most significant difference between CA and ISK is the taxation pattern. The former is a gain-realization tax scheme while tax is levied independently from capital gain(or loss) and holding period. The investor doesn't need to pay any tax until the financial instrument is sold and the gain is realized. Meanwhile, the realized loss can be deducted to offset the gain when dealing with taxation. Both CA and ISK are available to savers under the current scheme. The investors may allocate their portfolios over CA and ISK based on their preferences. Thus, the impacts of this exogenous change in taxation on Swedish market and individual investors might be reflected on various aspects.

6.2.1 Trading volume

Figure 1 reflects the monthly-average daily traded volume on Swedish stock markets, and daily traded volume is calculated as the total number of shares traded during the trading day. As shown in the figure, the movement of trading volume of Swedish stocks mimics the trend of the market perfectly, and the majority of traded shares on the Swedish markets are local shares, with a proportion of around 90% on average. Before 2012, the trading volume had been relatively volatile and was on a downward trend which could be affected

Figure 1: Average daily traded volume by month



Notes: The red vertical line corresponds to January 2012, the month when ISK was introduced. The Y-axis depicts the average number of daily traded volumes in each month from 2005 to 2019. The gray line includes all companies listed on the major five markets including two stock exchanges and three MTFs. The blue line only includes Swedish companies that report to Euroclear Sweden and that are also traded on these markets. Data is from Finbas and Euroclear Sweden.

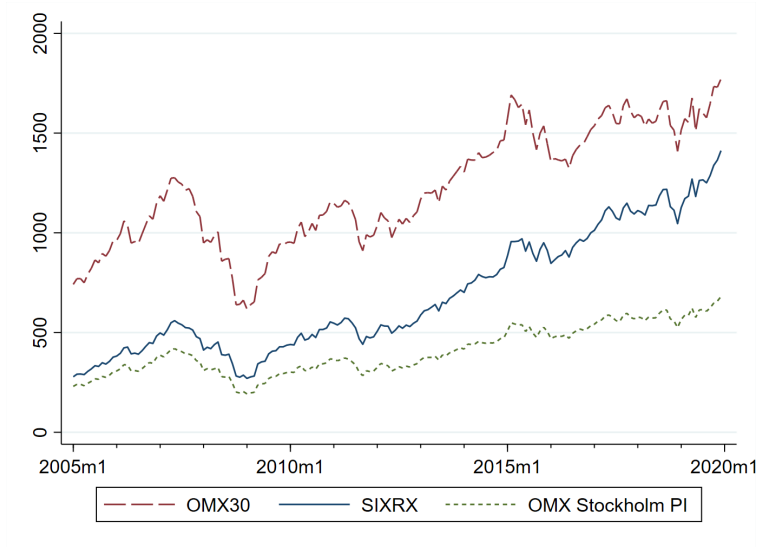
by the financial crisis around 2008 and the European debt crisis in 2011. From 2012, the fluctuation of trading volumes became milder and exhibited a gentle upward trend instead. The market recovery tendency after 2012 might be partially attributed to the introduction of ISK, and this would also have advocated the acceptance of the ISK among investors in turn.

6.2.2 Market indices and number of stocks

In order to get a clearer picture of the Swedish stock market movement, three major Swedish market indices are shown in Figure 2. Consistent with the trading volume change, all these three indices revealed the same declining pattern around the 2008 and 2011 crises, and the market was also negatively affected by Brexit in 2015. In this figure, the rising trend that started around the beginning of 2012 coincides with the time of ISK introduction, indicating there might be a positive correlation between ISK introduction and the prosperity of the Swedish stock market.

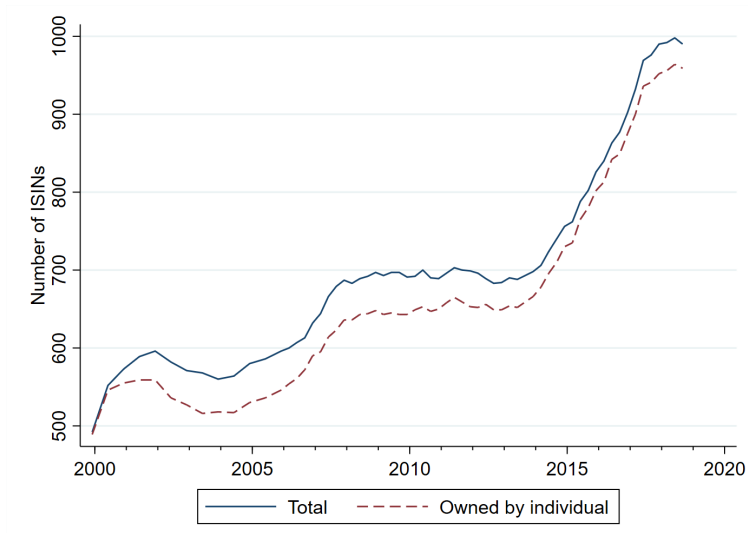
Figure 3 depicts the number of all Swedish stocks traded on Swedish markets and the number of stocks held by individual investors. As shown in the picture, these two curves had been moving in parallel during most of the period until the beginning of 2014, with an expanding period spread from 2005 to 2007 and followed by a stable stage from 2008. Since 2014 beginning, the number of listed stocks skyrocketed and the proportion of shares held by individuals also increased. This phenomenon might also be related to the introduction of ISK in 2012 as ISK offers more flexibility on portfolio re-balance for private investors.

Figure 2: Swedish stock market indices



Notes: The Swedish market indices data is from Finbas.

Figure 3: Number of ISINs



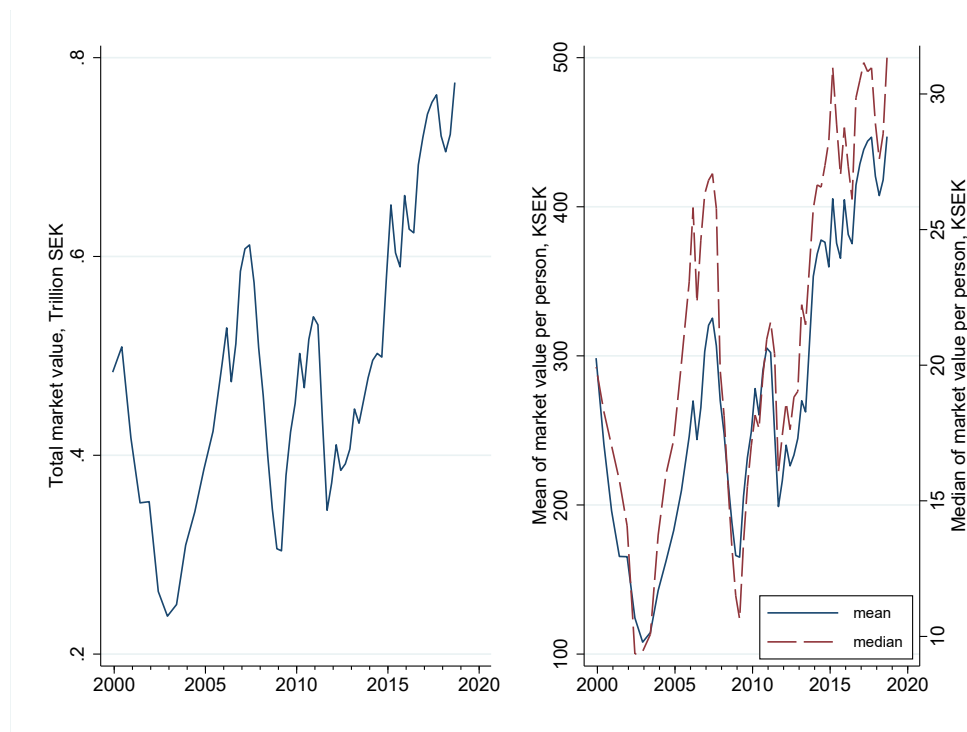
Notes: Blue line is the total number of ISINs of Swedish companies listed on the five major markets in Sweden, reported by Euroclear Sweden. Red line is the total number of ISINs held by individual investors. Data is from Euroclear Sweden.

6.3 Individual investor effects

In addition to the part of effects that might have been reflected in the aggregate market performance, the impacts of ISK may be exemplified by the pattern of individual investment movement.

6.3.1 Individual investor market value

Figure 4: Total market value and summary statistics of market value per individual investor

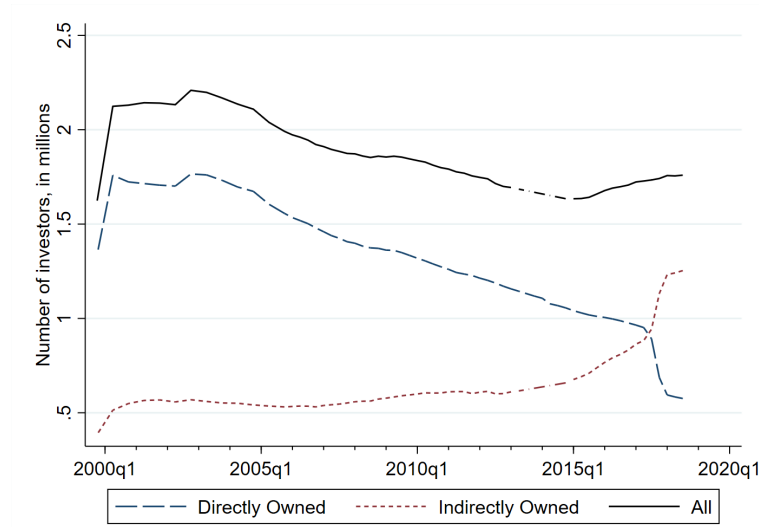


Notes: The left panel depicts the total market value of shares of Swedish companies listed on the five major markets in Sweden, held by individual investors and reported by Euroclear Sweden. The right panel illustrates the mean and median of the total market values per person. Data is from Finbas and Euroclear Sweden.

Figure 4 reveals the change in share market value held by individual investors in stock exchanges and MTFs. The total market value owned by individuals in the left panel and summary statistics of market value per individual in the right panel resemble each other and represent a rapidly increasing trend since 2012. Over all these years, the share of market value owned by individuals has been relatively stable at around 10%, indicating the market value owned by individual investors moves closely together with the market. This may also indicate that investors are prone to lift their investment amount in the stock market with the facility of ISK from 2012.

On the other hand, the number of total individual stock investors moves towards another trend. As depicted in Figure 5, the number of individual investors had actually been slightly decreasing from the beginning of the 2000s up to 2015 while the investing value per individual was increasing except during the 2008 and 2011 crises. After taking a closer look at the distribution of the types of owners categorized by directly owning

Figure 5: Number of Swedish individual investors



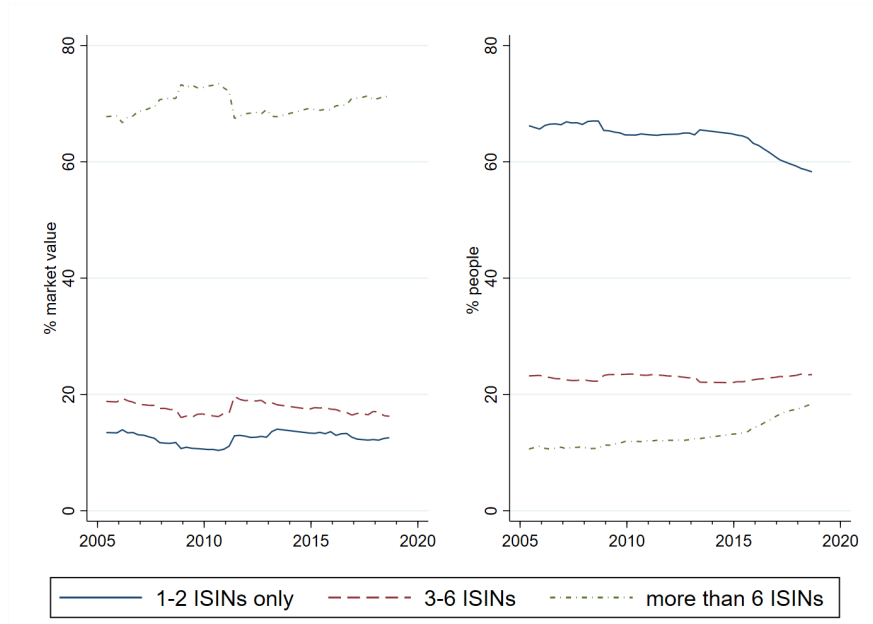
Notes: The dashed-dot lines of directly owned accounts and all counts corresponding to the period 2013 September - 2014 September when the Euroclear Sweden shareholder dataset is incomplete. The numbers of account owners during this period are thus estimated based on the values before and after assuming smooth change. Data is from Euroclear Sweden.

stocks in the Euroclear direct securities account and indirectly owning stocks in the custody account and ISK, we could notice that the decreasing trend of total investors is mainly driven by the part of investors only own stocks directly. On the contrary, the number of owners with indirect accounts has been increasing since the beginning, and skyrocketed after 2015. Since ISK is considered as indirect account, this trend may also be explained by the popularity of ISK since 2015.

6.3.2 Individual investor structure

Based on the figures stated above, it could be concluded that the aggregate value from individuals' investments in the stock market has been increasing from 2012 up to 2019 in Sweden, and the average market value per individual has been rising along with the Swedish stock market during the same period. The section further analysis the structure of individual investors from the scope of the number of stocks owned by each individual. As stated in Figure 6, I roughly categorized individual stock investors into 3 groups based on the number of stocks they own, identified by the stock ISINs. Individuals owning only 1-2 Swedish stocks might be regarded as investors with un-diversified portfolios, individuals owning 3-6 stocks have a moderate level of portfolio diversification, and individuals owning more than 6 stocks could be considered as well-diversified and might be more experienced in stock investment. As indicated in the right panel of Figure 6, almost half of the investors own only 1-2 stocks, and less than 20% of investors have highly diversified stock portfolios before 2017. On the other hand, the majority of stock values are owned by a minority of people as shown in the left panel, which is consistent with the wealth distribution. Another interesting trend is that in the right panel, the shares of investors with only 1-2 stocks started to decline approximately around 2013 while the

Figure 6: Percentage of market value and owners, by the number of stocks owned



Notes: Owners denotes Swedish individual investors who have shares of Swedish companies traded on the five major markets in Sweden in holding, reported by Euroclear Sweden. The denominators are the total market value held by all Swedish individual investors and the number of all investors respectively. Data is from Finbas and Euroclear Sweden.

shares of investors with more than 6 stocks started to rise at the same time. Considering the fact of ISK's introduction in 2012 and the effect of this policy change might be lagged, it might be reasonable to partially attribute this trend of improved portfolio diversification among individual investors to ISK.

7 Scenario Analysis

From the descriptive figures above, we could observe that the stock market and aggregate private stock investors' activity have expressed a positive trend concurrently with the introduction and expansion of ISK since the beginning of 2012. However, it is still obscure to which extent the prosperity could be attributed to ISK which acts as a supplementary investment channel for individuals. Also, the Swedish government had been implementing relatively easy money and fiscal policies during the first decade after ISK's introduction, thus it would be interesting to analyze how individuals' attitudes towards ISK would alter in a counterfactual economic background. In this context, this chapter designs a series of scenario analyses to further discuss the effects of portfolio heterogeneity and interest rate on individuals' preference between ISK and CA.

7.1 Simulation setup

Many researchers have discussed the distribution of stock prices, and one of the most common and classical models used for predicting stock price is the geometric Brownian motion model. The geometric Brownian

model is widely used in the field of asset pricing and it is also the basis of the well-known Black-Scholes-Merton model for pricing options. Under this assumption, the stock price process is believed to follow a log-normal process which could be customized by tuning the drift and variance parameters.

This paper uses Monte Carlo simulation with the geometric Brownian model to simulate monthly stock prices, where the expected value and variance of stock returns are determined using the CAPM model. Using the predicted stock prices in each term, the annualized after-tax returns are then calculated under different investment horizon and interest rate scenarios for both CA and ISK tax schemes.

7.1.1 Geometric Brownian Motion model for stock price

The geometric Brownian model depicting the stock price process and the log-normal feature of stock returns could be expressed below.

Let S_t denote the price of the stock at time t , it follows a Geometric Brownian motion:

$$dS_t = \mu S_t dt + \sigma S_t dB_t$$

In this equation, μ is the drift coefficient or scale coefficient that measures the price-changing trend, and σ is the volatility coefficient that indicates the variability level of prices. The random walk part B_t is Brownian motion which is a continuous stochastic process satisfying $B_t \sim \mathcal{N}(0, t)$.

After applying Itô's Lemma and Euler discretization, the discretization of this geometric Brownian motion process could be described as:

$$S_t = S_0 e^{(\mu - \frac{1}{2}\sigma^2)t + \sigma\sqrt{t}Z}$$

where S_0 is the stock initial price and Z denotes the standard normal distribution $\mathcal{N}(0, 1)$.

When the time interval equals to 1, and let $L(t) = \log(\frac{S_t}{S_{t-1}})$ denote the logarithmic return at time t over one time period, this equation could be rewritten as:

$$L(t) = (\mu - \frac{1}{2}\sigma^2) + \sigma Z.$$

Hence, for a specific stock i with arithmetic total return over one time period expressed as $R_{i,t} = \frac{S_{i,t}}{S_{i,t-1}}$, we could derive that stock logarithmic return follows normal distribution:

$$\log(R_i) \sim \mathcal{N}(\mu_i - \frac{1}{2}\sigma_i^2, \sigma_i).$$

And the stock total return R_i follows a lognormal distribution. In this case, the drift parameter μ_i and volatility parameter σ_i of the lognormal distribution could be estimated using moments of the total return

R_i :

$$\mu_i = \log(E[R_i]) \quad (1)$$

$$\sigma_i^2 = \log\left(\frac{Var(R_i)}{E[R_i]^2} + 1\right) \quad (2)$$

where $E[R_i]$ is the expected value of R_i and $Var(R_i)$ is the variance.

7.1.2 CAPM

Under the setup of the single-factor Capital Asset Pricing Model (CAPM), the expected risk premium of stock i under equilibrium could be expressed as :

$$E[r_i] = \beta_i(E[r_m] - E[r_f]) + E[r_f] \quad (3)$$

where r_i is the simple arithmetic cum-dividend return of stock i that equals $R_i - 1$, $E[r_m]$ is the expected market return and r_f is the risk-free rate.

The relationship between stock return and market return could also be stated as:

$$r_i - r_f = \beta_i(r_m - r_f) + \epsilon_i \quad (4)$$

where β_i measures the systematic risk and the error term ϵ_i reflects the idiosyncratic risk of stock i with $E[\eta_i]$ equals to 0.

Thus, the total volatility of stock return $Var(R_i)$ could be decomposed as the sum of systematic and idiosyncratic volatility:

$$Var(R_i) = \beta_i^2 Var(R_m) + Var(\epsilon_i). \quad (5)$$

7.1.3 Simulation steps

To simulate the hypothetical logarithmic return paths of stocks with heterogeneous systematic and idiosyncratic risks as the prerequisite procedure for post-tax returns estimation in CA and ISK, I followed the steps as below:

1. Calculate the moments of monthly excess market return and expected risk-free rate using historical series of Swedish market returns and risk-free rate.
2. Estimate the expected value of stock monthly return $E[r_i]$ according to equation (3) and the variance of stock return $Var(R_i)$ according equation (5). The moments of market returns are taken from calculations in the previous step and β_i and $\sigma_{\epsilon,i}$ are parameters used as input.
3. Calculate the drift and volatility parameter μ_i and σ_i using results from the last step applying

equations (1) and (2).

4. Simulate N paths of monthly logarithmic returns $\log(R_i)$ for investment horizon T , assuming $\log(R_i)$ follows normal distribution with mean equals to $\mu_i - \frac{1}{2}\sigma_i^2$ and variance equals to σ_i^2 .
5. Repeat the previous steps to simulate returns for a collection of stocks with different β and σ_ϵ values.

7.2 Scenarios for post-tax returns

With the series of simulated logarithmic returns of stocks, it is now possible to further impute post-tax returns of both CA and ISK under different scenarios with various investment horizons and interest rates. It should be noted that simulation would be unnecessary when the variable of interest is pre-tax return, as the moments of $\log(R_i)$ could be derived from the moments of R_i when assuming the return follows a lognormal distribution. However, since the taxation of ISK is determined by the capital base which is taking the sum of the quarterly balance into account, the relationship between pre-tax and post-tax returns is not linear. Thus, calculating post-tax returns based on simulated return series would be helpful in understanding the tax situation for individual investors when choosing between CA and ISK.

For simplification, this paper assumes individuals may choose between CA and ISK, and they only invest in one stock in the portfolio. The stock is assumed to be purchased at beginning of the investment horizon T and sold at the end of T , the portfolio is not re-balanced during the whole period and all the dividends are assumed to be reinvested in the same account.

Thus, the taxation upon CA would only be triggered by the sale. To add some variation, I further assume two scenarios regarding capital loss deduction. In one scenario, the post-tax return of a CA is without tax deduction and is simply expressed as $\tau R^{pre-tax}$ where τ is the tax rate for capital income. While in the other scenario, the negative pre-tax return by the end of T could be fully considered for capital loss deduction according to the taxation regulation of capital income upon security sales.

For investment in ISK, it is assumed that the money is already in the CA and ISK at the beginning of horizon T , thus there is no need to include the initial investment value as a new deposit when calculating the capital base in the first year. Since the tax rate of ISK depends on the standard interest rate r_s , I further set up ISK scenarios with various r_s levels. The yearly taxation of ISK is imputed as described in 3.2, where the capital base is imputed using the value in account at the beginning of each quarter.

After applying the methodology above, for each stock i under each scenario, I am able to impute its annualized post-tax return of N simulated paths. For analysis, I further calculate the mean of N paths of annualized post-tax returns for each combination of β , σ_ϵ , T , r_s for ISK and CA with different tax deduction assumptions.

7.3 Parameters

To ensure the simulated returns follow desired distribution, the number of simulations N is chosen as 10,000. From the historical transaction record, most of the Swedish stock owners are not active traders and they don't sell any stocks within a one-year horizon.⁹ Thus, the investment horizon T is chosen among 1 year, 2 years, 5 years, and 10 years.

The tax rate for capital income τ is 30% according to the Tax Agency's regulation. For ISK, the standard interest rate values used in the analysis are 1.25%, 1.85%, 2.45%, 3.05%, and they are chosen in reference to historical values in Table 2 with the minimum threshold 1.25%.

The stock's systematic and idiosyncratic parameters β and σ_ϵ are chosen in accordance with the distribution of real-world values of Swedish stocks listed on the Swedish market. Utilizing CAPM, I estimated β and σ_ϵ of 1,700 stocks using their historical monthly returns and the SIXRX (SIX Return Index) return during 1983m2-2021m12. The range of parameters used in the simulation is then set up by taking the approximate bottom and top 10 values from β and σ_ϵ of these 1,700 stocks.

Table 4 shows the combination of β and σ_ϵ and the corresponding drift and volatility parameters used in the simulation. The excess expected market monthly return and risk-free rate used are 0.87% and 0.41% respectively.

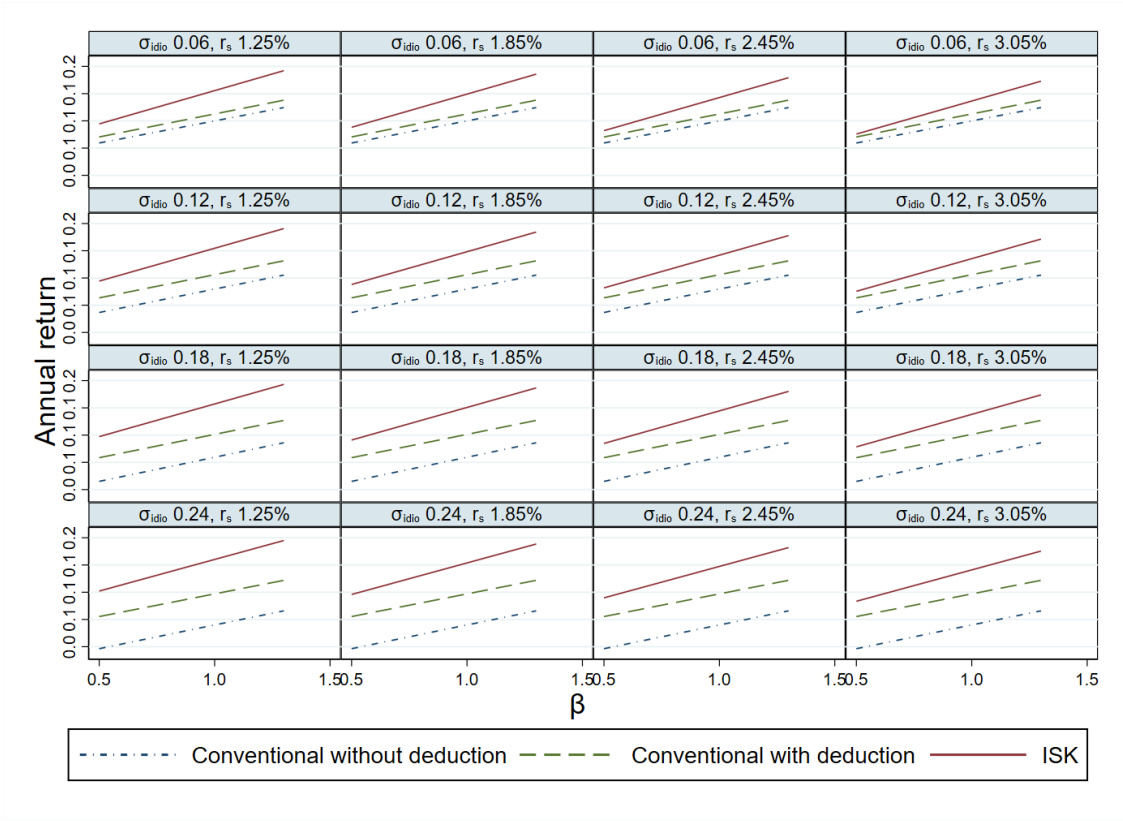
Table 4: Simulation parameters

β	σ_{idio}	μ	σ	u
0.3	0.06	0.0067	0.0621	0.0048
0.3	0.12	0.0067	0.1200	-0.0005
0.3	0.18	0.0067	0.1782	-0.0092
0.3	0.24	0.0067	0.2357	-0.0211
0.7	0.06	0.0101	0.0719	0.0076
0.7	0.12	0.0101	0.1251	0.0023
0.7	0.18	0.0101	0.1813	-0.0063
0.7	0.24	0.0101	0.2376	-0.0181
1.1	0.06	0.0136	0.0868	0.0098
1.1	0.12	0.0136	0.1338	0.0046
1.1	0.18	0.0136	0.1870	-0.0039
1.1	0.24	0.0136	0.2416	-0.0156
1.5	0.06	0.0170	0.1044	0.0116
1.5	0.12	0.0170	0.1455	0.0064
1.5	0.18	0.0170	0.1951	-0.0020
1.5	0.24	0.0170	0.2475	-0.0136

Notes: μ denotes the drift parameter and σ denotes the volatility parameter in the geometric Brownian motion. u is calculated as $\mu - \frac{1}{2}\sigma^2$ which is the mean of the lognormal process that return follows.

⁹Self-calculation using number of sales records in KU31.

Figure 7: Return vs beta, horizon = 1 year

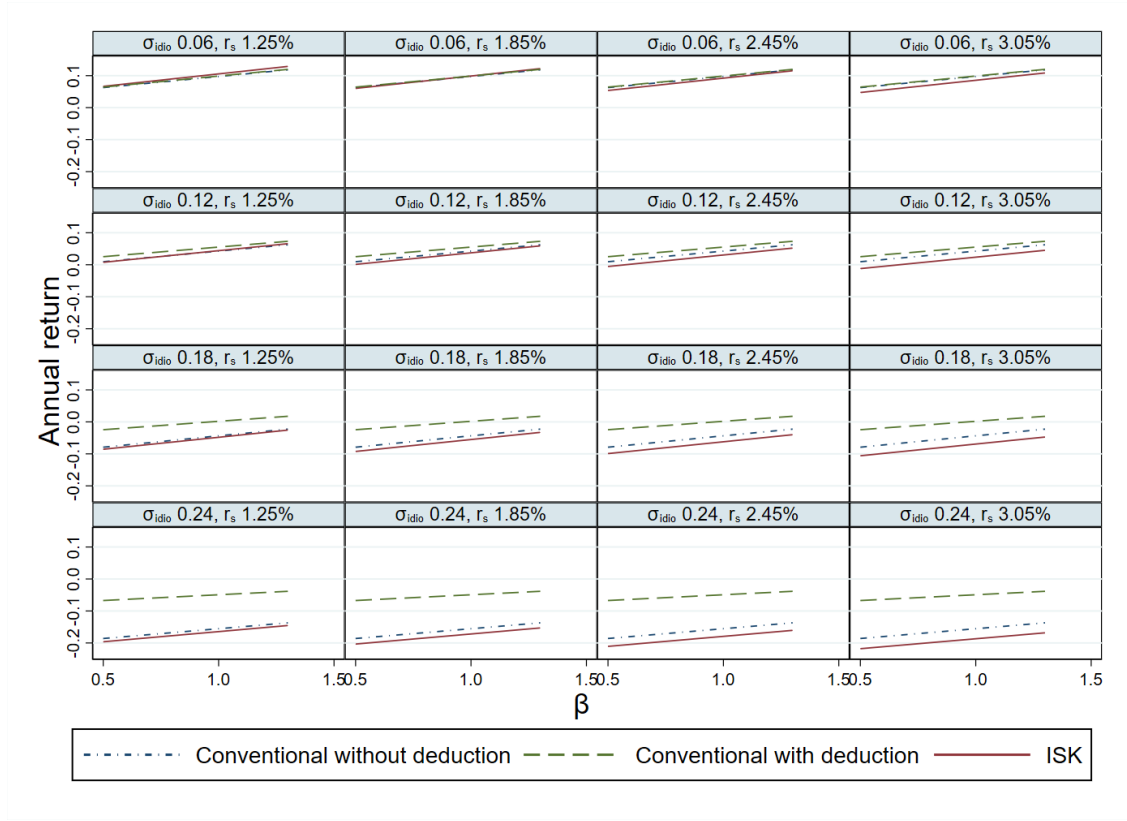


7.4 Simulation results

Based on the simulation results, the annualized after-tax returns of CA and ISK calculated according to descriptions in 7.1 and 7.2 are reported in Figure 7 and Figure 8. The vertical axis in these two figures represents annualized returns after taxation in the corresponding account type. The values of grouping variates σ_{idio} and r_s and also β on the horizontal axis are determined based on Table 4. Due to space limitations, only the two representative scenarios with investment horizons of 1 year and 10 years are listed in the main text. The other simulation results are listed in Appendix C.

Figure 7 indicates ISK's superiority in short-horizon investments. Among all these scenarios, the average post-tax returns are positive, and ISK outperforms CA in the scope of average annualized post-tax returns. And CA with a full tax-deduction possibility is superior to the one without deduction due to the taxation offset brought by deduction in cases of capital losses. We could also notice that the gap between CA and ISK enlarges when system risks β increase. The trend and range of ISK returns are quite stable across all these scenarios, only slightly negatively affected by the high standard interest rate in combination with low beta as shown in the four plots in the last column. On the contrary, the conventional accounts appear to be more sensitive to σ_{idio} , and the magnitude of returns in the frame without tax deduction is quite close to 0 when β is low and idiosyncratic risk is high.

Figure 8: Return vs beta, horizon = 10 years



These results are relatively reasonable in the sense that in a short investment horizon of one year, the proportion of capital gain tax in ISK is smaller than that in CA. This is because the taxed income in ISK is the imputed standard interest income instead of the actual returns, and the standard interest rate which is set comparable to the long-term risk-free rate should be lower than stock returns in most cases. Also, within a short holding horizon, the taxation of CA would be predominately affected by price fluctuations in the short term and would be more volatile than taxation in ISK when the stock idiosyncratic risk changes.

Figure 8 reflects a more extreme scenario where the investment horizon is 10 years and mimics a longer-term buy-and-hold strategy. From the plots in the top two rows, we could observe the superiority of ISK diminishes in the long run. Contrariwise, the bottom two rows indicate that CA outperforms ISK when the stock idiosyncratic risk is large. This effect should be mostly driven by the tax-deduction nature, as the returns of CA without deduction assumption are more similar to ISK returns.

These results imply that a CA, especially a CA with a tax deduction setup is beneficial in the long run and could provide investors with a certain extent of protection against risk from investment failure. When individual investors suffer from stock losses, the tax deduction scheme in CA acts as a shield to a certain degree, whereas the capital income tax in ISK is not exempted. This effect is accumulated as the investment horizon prolongs and becomes more deteriorated when stock idiosyncratic risk increases.

To conclude, the advantage of investing in ISK is more significant in the short term for stocks with large systematic risk and idiosyncratic risk. Intuitively, it would be more beneficial for private investors with high portfolio re-balancing frequency to choose ISK over CA. On the contrary, CA provides investors with partial protection from capital losses due to its tax-deduction character and might thus be more favored by individuals with high risk-aversion levels or choosing a buy-and-hold strategy. Also, the magnitude of idiosyncratic risk appears to play an important role, especially in a long investment horizon setting. ISK returns are weakly affected by the increase in standard interest rate, but the impact is not significant compared to those led by stock risk changes.

This scenario analysis suffers from several shortcomings as it only describes an ideal world where stock returns are lognormally distributed and the investors' portfolio allocations and horizons fit the according to hypothetical settings. Also, the tax deduction is also simplified as there exists an upper limit for deduction on capital loss in the reality. In this context, this analysis may overestimate idiosyncratic risk, as investors could diversify their portfolios with more than one stock and even blend with other types of assets and benefit from lower portfolio idiosyncratic risk. Additionally, The horizon setup is quite rigid, and real-world investors may behave differently when a stock exhibits poor performance in a relatively long term. In addition, the complexity of traditional account taxation could not be quantified in this analysis and the superiority of conventional could be exaggerated from this aspect. Thus, this paper conducts an empirical analysis based on a sub-sample of dividend-paying stocks in Sweden in the next section to further analyze this issue.

8 Empirical Analysis

The scenario analysis suggests that stocks with higher β would be more popular among individual investors after ISK has been introduced as a supplementary investment channel in the short term, and ISK would be more popular among individuals with high re-balancing frequency. In addition, the high idiosyncratic risk stocks might be less favorable in ISK taxation scheme if investors are more risk-averse and prefer a long-term holding horizon.

Due to the defects in the scenario analysis, an empirical analysis is done using the stock holding data to test the deductions above. Also, the preference and allocation between CA and ISK may differ depending on investors' personal and trading characteristics, and the empirical analysis may provide some insights into this interesting topic.

8.1 Empirical sample and ISK share imputation

Ideally, to analyze the heterogeneity of investors' portfolio allocation between CA and ISK, it would be natural to compare the holding data in these two types of accounts. However, this is not as straightforward as it appears due to data availability. As discussed in section 5.1, the shareholder dataset from Euroclear

Sweden doesn't differentiate the shares in the indirect custody account and ISK, and it would be difficult to separate the effects driven by ISK introduction from the mixed aggregation. Also, after the abolition of the wealth tax in 2007, the KU31 tax form no longer reports the shares held in conventional accounts.

Luckily, even though the stock holding is not reported in tax forms after ISK's introduction, KU31 still reports the value of listed stocks' dividend yields in conventional accounts for capital income taxation. Combining the value of dividends paid per share from Finbas, it would be possible to infer the approximate number of shares of dividend-paying stocks in individuals' conventional investment accounts during the year by the time of dividend payout. Subsequently, the sum of shares in conventional and ISK accounts of these dividend-paying stocks could be estimated using the total shares held by Swedish individuals in Euroclear Sweden's shareholder dataset at the end of the dividend-payout quarter. Thus, the shares held by individual investors in ISK could be calculated as the difference between the total number of shares from Euroclear and the number of shares held in conventional accounts derived from KU31.

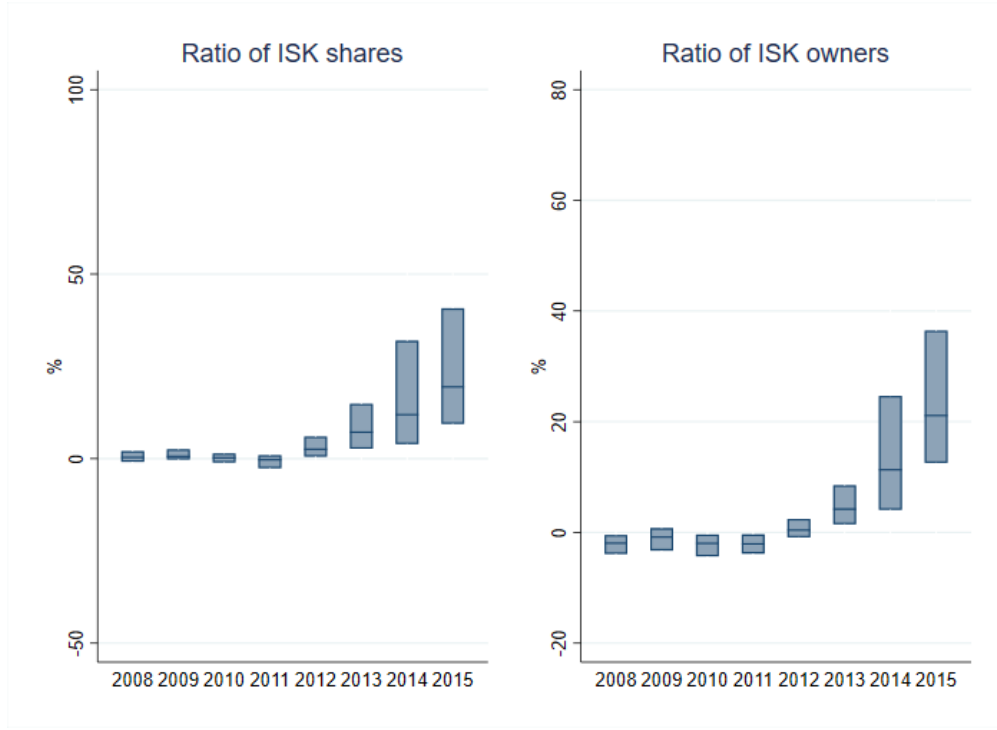
Table 5: Dividend-paying stocks

Year	Number of ISINs with dividends	Number of ISINs with dividends (%)	Market value of ISINs with dividends (%)	Dividend Yield median
1999	230	55.42%	83.05%	3.09%
2000	212	42.40%	88.55%	3.00%
2001	196	40.92%	91.90%	3.26%
2002	172	39.36%	88.02%	3.05%
2003	176	42.41%	81.34%	3.68%
2004	180	42.45%	80.21%	3.41%
2005	187	41.28%	91.92%	3.20%
2006	214	41.96%	92.89%	2.57%
2007	230	40.78%	94.97%	2.65%
2008	232	40.99%	96.24%	3.95%
2009	195	35.07%	91.98%	4.56%
2010	207	36.70%	92.02%	3.23%
2011	232	40.99%	96.19%	3.37%
2012	232	42.03%	95.90%	4.01%
2013	244	41.85%	93.84%	3.73%
2014	250	38.88%	94.77%	3.31%
2015	281	39.19%	86.77%	3.00%
2016	323	41.20%	89.59%	3.20%
2017	331	36.94%	91.72%	2.96%

Notes: The stocks included in this table are stocks from Swedish companies listed on Swedish stock exchanges and MTFs and held by Swedish individuals. The stock dividend yield in SEK is taken from Finbas dataset, and dividends paid multiple times in the same year are aggregated at the yearly level. The percentages of the number and market value of ISINs with dividends in columns 2 and 3 are divided by the total number and market value of ISINs held by individuals. The dividend yield in % is calculated as the dividend paid per share divided by the stock share price.

As shown in Table 5, around 40% of Swedish stocks traded on Swedish markets are dividend-paying stocks, and most of these stocks distribute dividends regularly once per year. The total market value of dividend-paying stocks corresponds to up to 90% of the total market value of stocks held by individuals. Thus, it would be appropriate to use the sample of dividend-paying stocks as the representative for listed Swedish

Figure 9: Imputed ISK shares and owners ratio



Notes: The imputed ISK shares are shares difference between conventional account shares estimated using KU31 and total shares in Euroclear Sweden data. Only dividend-paying stocks are included, and the numbers of shares and individual owners are aggregated at the ISIN level. For each box in the plots, the horizontal line that splits the box into half is the median, and the upper and lower hinges are 75% and 25% values respectively.

stocks. However, this ISK share imputation methodology discussed above is not flawless and there might be computational errors. First, it is rare for the stock dividend-paying date to coincide with the Euroclear holding date at the end of the quarter. Even though most Swedish individuals are passive traders and their trading frequencies are less than one time within one year, there might be cases in which owners bought or sold shares from CA, causing the difference in KU31-derived shares and Euroclear shares incorrectly attributed to ISK. Second, as mentioned in 5.1, unfortunately, the Euroclear data I have access to is missing the 2013 September data, and the 2013 December - 2014 September data is incomplete. Thus, for stocks paying dividends during this time period, the total shares of ISK and CA are taken from the closest quarter with complete data, and the time gap enlarges the effects from unobserved transactions argued in the previous point. Third, unlike ISK, the conventional custody account could be jointly owned by multiple individuals, and it is possible to distribute the dividend and tax to each owner proportionally in KU31. However, it is observed that Euroclear Sweden may treat the shares ownership of jointly owned accounts differently than the Tax Agency and sometimes all shares of the account are attributed to one owner in Euroclear holding data.

As a robustness check of the methodology used for imputing ISK shares in this paper, I further calculated the distribution of imputed ISK shares and new ISK owners for each listed stock in Figure 9. The ratio in the left

panel is calculated from the number of ISK shares divided by the total shares in Euroclear Sweden holdings. The ISK owners defined in the right panel are individuals who only invest the particular stock in ISK, thus their shares are only observed Euroclear Sweden holdings and not in KU31. It could be observed that the median of ISK share and ISK exclusive owners grew steadily during 2012-2015, which fits the trend of ISK account growth among Swedish investors. Also, both ratios are relatively small and have medians around zero during 2008-2011 as baseline years before ISK introduction, which could also prove the estimation errors of this ISK share imputation method is at an acceptable level.

In comparison with the right panel of Figure 9 indicating the ratio of ISK-exclusive investors has increased steadily at the stock level every year, Table 6 shows that the total number of owners of dividend-paying stocks is stable and slightly declining since 2012, implying these ISK-exclusive investors are not new participants on dividend-paying stock investment. This inference is in accordance with the declining trend of the number of Swedish individual investors during 2012-2015 in Figure 5, and my interpretation of this phenomenon is that the ISK was not very effective in attracting new participants to the Swedish stock market until 2015, and existing investors were using ISK as a supplementary investment channel to optimize their portfolios.

Table 6: Number of owners of dividend-paying stocks

Year	Number of owners	Number of stocks
2008	1,775,759	233
2009	1,459,762	195
2010	1,541,532	207
2011	1,693,503	232
2012	1,643,883	232
2013	1,589,455	240
2014	1,566,971	248
2015	1,534,067	281

Notes: The numbers of stock owners are extracted from the Euroclear Sweden shareholder dataset in the (closest) quarter of the dividend-paying date. The number of ISINs deviates slightly from Table 5 in 2013 and 2014 due to the Euroclear data incompleteness from 2013 September to 2014 September.

8.2 Regression at ISIN level

Using the methodology described above, it is now possible to impute the number of shares owned in ISK at the individual level for a certain stock as shown in equation (6), where N_y^{ISK} stands for the number of shares of this stock owned in ISK in year y , q denotes the last quarter when the dividends are paid during the year, N_q^{ES} denotes the number of shares owned reported in Euroclear holdings dataset at the end of quarter q , DIV_y^{Tax} denotes the total value of dividends distributed to this individual from this stock as in tax declaration form KU31, and div_y is the total value of distributed dividends during the year per share.

$$N_y^{ISK} = \min\{N_q^{ES} - \frac{DIV_y^{Tax}}{div_y}, 0\} \quad (6)$$

To reduce the effects brought by estimation errors, the shares are aggregated at the ISIN level for the empirical analysis. And the outcome variable, the percentage of shares owned in ISK, is defined as:

$$ISK_{\%} = \frac{N^{ISK}}{N^{ES}} \quad (7)$$

Naturally, this outcome variable is closely related to the after-tax expected returns which is the variable of interest in section 7. Investment decisions of rational investors should be driven by the expected returns and the higher after-tax expected returns in ISK in addition to that in CA would lead to a higher percentage of shares invested in ISK.

As an attempt to analyze the factors that might impact individual investors' choices of ISK over CA, I ran a series of regressions using a combination of regressors described below. Lagged values in the last year are used for yearly returns and yearly dynamic idiosyncratic risks in the regressions, as investors could not predict the stock returns in the future, and their decisions are made upon past performances.

- r_s : ISK standard interest rate, in %.
- Dividend yield: Calculated as the dividend value per share divided by the stock price per share.
- σ_{5years} : The stock's rolling idiosyncratic risk, calculated using monthly returns over the last five years. The minimum number of return observations is 24.
- β_{5years} : The stock's rolling systematic risk, calculated using monthly returns over the last five years. The minimum number of return observations is 24.
- Male: The percentage of male owners, weighted by the number of shares owned.
- Age: The average age of owners, weighted by the number of shares owned.

The final sample includes 367 unique dividend-paying stocks identified by their ISINs, and the regressions are run on an unbalanced panel during 2012-2015. As shown in Table 7, the number of observations slightly decreased when including rolling β and σ which require at least 24 months of historical stock returns.

In Table 7, model (1) is the basic model where only the two major explanatory variables, ISK standard interest rate and stock dividend yield, and the fixed effects are included. Compared to model (1), model (2) to model (5) also include the stock idiosyncratic and systematic risk parameters σ and β as discussed in the scenario analysis in section 7. The σ and β values used in regressions are calculated using the monthly returns on a rolling 5-year basis, not calculated as constant values as in section 7. This is because the majority of real-world investors are unlikely to be accessible to historical returns back to the 1980s and they may make investment decisions based on stocks' recent historical performance. Five-year appears to be a reasonable length in this case. To further analyze the other factors that may affect the percentage of shares owned in ISK, I also added two demographic variables related to the gender and age of the stock owners in

the models (6) to (8). In all these models, boundary values of 0 and 100 in the outcome variable are removed as they might be largely explained by the ISK shares imputation errors.

Table 7: Regressions of ISK shares % at ISIN level

	(1) ISK share %	(2) ISK share %	(3) ISK share %	(4) ISK share %	(5) ISK share %	(6) ISK share %	(7) ISK share %	(8) ISK share %
r_s	-29.13*** (-12.67)	-25.68*** (-12.87)	-24.20*** (-12.09)	-25.84*** (-12.98)	-25.92*** (-13.09)	-24.87*** (-12.79)	-25.85*** (-13.08)	-24.84*** (-12.79)
Dividend yield	178.9*** (14.75)	152.0*** (14.77)	158.0*** (15.23)	149.9*** (14.55)	149.4*** (14.58)	148.3*** (14.79)	149.1*** (14.58)	148.0*** (14.79)
σ_{5years}		78.75*** (4.95)		84.86*** (5.27)	3.357 (0.10)	-29.19 (-0.91)	-5.321 (-0.16)	-35.59 (-1.11)
β_{5years}			-1.799 (-1.40)	-2.924* (-2.28)	-12.21*** (-3.56)	-9.419** (-2.78)	-11.54*** (-3.36)	-8.932** (-2.63)
$\beta_{5years} \times \sigma_{5years}$					95.63** (2.92)	80.26* (2.49)	91.26** (2.78)	77.01* (2.39)
male						29.26*** (5.84)		28.65*** (5.71)
age							-0.241* (-2.12)	-0.197 (-1.77)
Constant	47.21*** (15.90)	34.17*** (12.46)	40.43*** (13.85)	36.71*** (12.43)	44.82*** (11.08)	23.06*** (4.24)	59.73*** (7.38)	35.69*** (3.98)
Observations	826	742	742	742	742	742	742	742
R^2	0.339	0.371	0.352	0.375	0.381	0.408	0.384	0.410

Notes: The t-statistics are in parentheses, significant levels are * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable is calculated as ISK shares among the total shares owned by individuals at the ISIN level, and the value is taken between 0 and 100 percentage points excluding boundaries. Yearly fixed effects and company sector fixed effects are included in all models.

As indicated by the results, the adjusted R^2 values in Table 7 increases along with the model evolution. Model (1) shows a strong and significant negative effect of ISK standard rate and a significant positive effect of dividend yield on ISK shares percentage, which are also reflected in all other models. This is consistent with the argument in scenario analysis where returns in ISK become less superior to returns in CA in a short investment horizon when ISK standard rate increases. As dividends are taxed 30% in the year of distribution in CA, whereas in ISK there is no taxation for dividends, investors would thus prefer to purchase shares with higher dividends yield in ISK over CA to reduce tax costs. By nature, the percentage of ISK shares would increase along with the dividend yield.

After incorporating stock idiosyncratic and systematic risk characteristic variables σ and β , it is easy to conclude from the regressions (2) to (5) that the idiosyncratic risk σ would positively affect the percentage of shares in ISK. This is also consistent with the simulation results in Figure 7. When comparing model (2) with models (4) and (5), it could be inferred that the positive effect from σ and β mainly comes from the interaction term, and the positive effect from solely idiosyncratic risk σ becomes weak and no longer significant after adding the interaction term. This indicates that the stocks with higher risks are more favorable for private investors when investing in ISK, and it is in line with the basic investment rule that higher returns are associated with higher risks. On the other hand, contrary to the indications in Figure 7 and Figure 8, the stock systematic risk β has a less strong but still significant negative effect on the

percentage of shares in ISK in these regressions. The inference that investors might tend to reduce the investment in ISK when stock systematic risk is larger is somehow counter-intuitive, and it might be partly explained by speculation or hedging motivations of investors when allocating portfolios. This could also be related to the investors' irrational preferences or other factors not included in the regression.

Models (6) to (8) add the investor characteristics including gender and age to model (5). It could be observed that the gender effect is strong and positive and the effects from stock idiosyncratic and systematic risks become weaker after adding gender. There is also a weak negative effect of age. These results are quite reasonable since males and younger persons are more inclined to high risks, and they might be more prone to accept ISK as a new investment channel.

9 Conclusion

This paper mainly discusses the introduction of Swedish Investment Saving Account (ISK) in 2012 and its impact on Swedish individual investors' stock investment behavior. The main difference between ISK and conventional account (CA) is that stocks in ISK are taxed at a relatively low flat-rate based on the account balance, whereas stocks in CA are taxed 30% of the distributed dividends and realized capital gains upon sales in a much more complex way. Thus, private investors might be motivated to choose ISK as an alternative investment channel as it is both simple and tax-favorable when they have capital gains from selling stocks and when they hold dividend-paying stocks. The establishment of ISK might thus promote stock market participation and activation level in the Swedish stock market.

In line with the assumptions above, the macroeconomic data shows that the Swedish stock market has been on an upward trend since the introduction of ISK in 2012, and there were the same trends for both total and *per capita* stock market values held by Swedish individual investors. Additionally, the percentage of individuals with un-diversified stock portfolios represented a decreasing trend since 2013, which might also be related to ISK.

From the scenario analysis and simulation results, it could be inferred that in terms of after-tax expected returns, ISK would be superior to CA for individual investors when the investment horizon is short as one year. The gap between ISK and CA enlarges when stock systematic risk β and idiosyncratic risk σ increase. On the other hand, in a long-investment-horizon setup of 10 years, it would be more beneficial for investors to choose the CA over ISK which might be explained by the possibility of tax-deduction in CA in case of capital losses.

In the empirical analysis, this paper further elaborates on the impacts of stock and investor characteristics on the preference of ISK using the microdata up to 2015 on a subsample of dividend-paying Swedish stocks. Similar to the simulation analysis, the regression results indicate that the interaction term of stock systematic and idiosyncratic risks has a significant positive effect on the percentage of shares invested in ISK. Also,

younger and male investors are more inclined to invest in ISK. However, the regression results also reflect that there might be a negative effect between stock systematic risk and the percentage of shares in ISK. This might be related to irrational individual investment behaviors and would be worth investigating in future research.

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Appendix A Glossary

List of Terms and Acronyms

CA

The conventional account (CA) is the traditional account before ISK introduction. Both direct securities account and custody account are CA.

custody account

Custody account (Swedish depå) is a type of account for investors to keep securities including shares. When shareholders own shares in this type of account, the financial intermediaries such as banks are registered as owners at Euroclear Sweden.

direct securities account

The Direct Securities Account (Swedish Värdepapperkonto, VP-konto) is a type of account for investors to keep securities such as shares. Owners holding shares in this type of account are directly registered at Euroclear Sweden.

IPS

Individual Pension Savings (Individuellt pensionssparande, IPS) is a type of private pension saving account in which people could keep securities. The maximum deduction premium was changed to 1800 SEK in 2015. After the abolition of the right of the tax deduction for private pension savings in January 2016, IPS is only favorable for people without occupational pensions or those who are self-employed.

ISK

The Investment Saving Account (Swedish Investeringsparkonto, ISK) is the new type of saving account available to investors since 2012.

KU

The examination information (Swedish kontrolluppgifter, KU) is the information that agencies such as companies and banks need to submit to the Swedish Tax Agency in order to facilitate tax declaration of private individuals.

nominee

Is a company licensed by Euroclear Sweden to hold an account on behalf of owners.

Appendix B Example of CA Taxation

B.1 Example of purchase cost calculation using the average method

Assume Svensson purchased 200 shares of BigCompany at the price of 100 SEK per share in 2002 with a 200 SEK brokerage fee. He then purchased another 300 shares of BigCompany in 2004 at the price of 150 SEK per share with a 200 SEK brokerage fee. In 2007, Svensson got 500 subscription rights when there was a new emission (1:1) with the subscription price of 10 SEK per share and he chose to buy 500 shares from his subscription rights. In 2010, there was a split (1:1) in the BigCompany. In 2011, he sold 500 shares at 20 SEK per share with a 100 SEK brokerage fee and he needed to declare the capital income from this sale in K4.

To correctly calculate the average purchase cost, Svensson needed to take all these BigCompany's corporate actions including the split and the new emission from 2002 to 2011, including his own additional purchases. His capital gain/loss in this purchase could be calculated as below:

- From the initial purchase in 2002, his average purchase cost per share was $(200 * 100 \text{ SEK} + 200 \text{ SEK})/100 = 20200 \text{ SEK}/100 = 202 \text{ SEK}$.
- After the additional purchase in 2004, the cost per share became $(20200 \text{ SEK} + 300 * 150 \text{ SEK} + 200 \text{ SEK})/(200 + 300) = 65400 \text{ SEK}/500 = 130.8 \text{ SEK}$.
- After the purchase from new emission in 2007, the cost per share became $(65400 \text{ SEK} + 500 * 10 \text{ SEK})/(500+500) = 70400 \text{ SEK}/1000 = 70.4 \text{ SEK}$.
- After the split in 2010, the total shares Svensson owned became 2000, and the total purchase cost was the same as in 2007, whereas his purchase cost per share became $70400 \text{ SEK}/2000 = 35.2 \text{ SEK}$.
- When Svensson sold 500 shares in 2011, his total earnings excluding brokerage from this sale was $500 * 20 \text{ SEK} - 100 \text{ SEK} = 9900 \text{ SEK}$. And the total purchase cost of these 500 shares should be $500 * 35.2 \text{ SEK} = 17600 \text{ SEK}$.

Thus, Svensson should report a capital loss of $17600 \text{ SEK} - 9900 \text{ SEK} = 7700 \text{ SEK}$ in his income declaration in 2012.

B.2 Example of capital gain and loss taxation

Following the example of Svensson discussed in B.1, this section further elaborates on the taxation deduction possibilities when the capital loss was related to the sale of shares owned.

B.2.1 Capital gain taxation

Assume in addition to the capital loss from selling BigCompany shares, Svensson also had capital gain of 6600 SEK from selling shares in WinCompany during the income year 2011. His total capital gain from selling shares would be 4983 SEK, and he would be taxed for $4983 \text{ SEK} * 30\% = 1495 \text{ SEK}$ (assuming no other capital incomes or losses).

B.2.2 Capital loss taxation

Assume the capital loss from selling BigCompany shares was the only capital income/loss that Svensson was supposed to declare in the income year 2011, then he could deduct $7700 \text{ SEK} * 70\% * 30\% = 1617 \text{ SEK}$ as only 70% of total capital losses from selling listed stocks could be tax-deductible.

B.2.3 Capital loss taxation with upper limit

Assume in addition to the capital loss from selling BigCompany shares, Svensson also had capital loss of 200,000 SEK from selling an apartment in the income year 2011. Since only 50% of capital losses from selling apartments could be tax-deductible, the total amount of his capital losses with the right to deduction was $1617 \text{ SEK} + 200000 \text{ SEK} * 50\% = 101617 \text{ SEK}$. When the capital loss is greater than 100,000 SEK, the tax deduction rate would be 21% of the excess amount instead of 30%. Assuming no other capital incomes or losses. Svensson could thus deduct $100000 \text{ SEK} * 30\% + 1617 \text{ SEK} * 21\% = 30240 \text{ SEK}$.

Appendix C Other Simulation Results

Figure 10: Return vs beta, horizon = 2 years

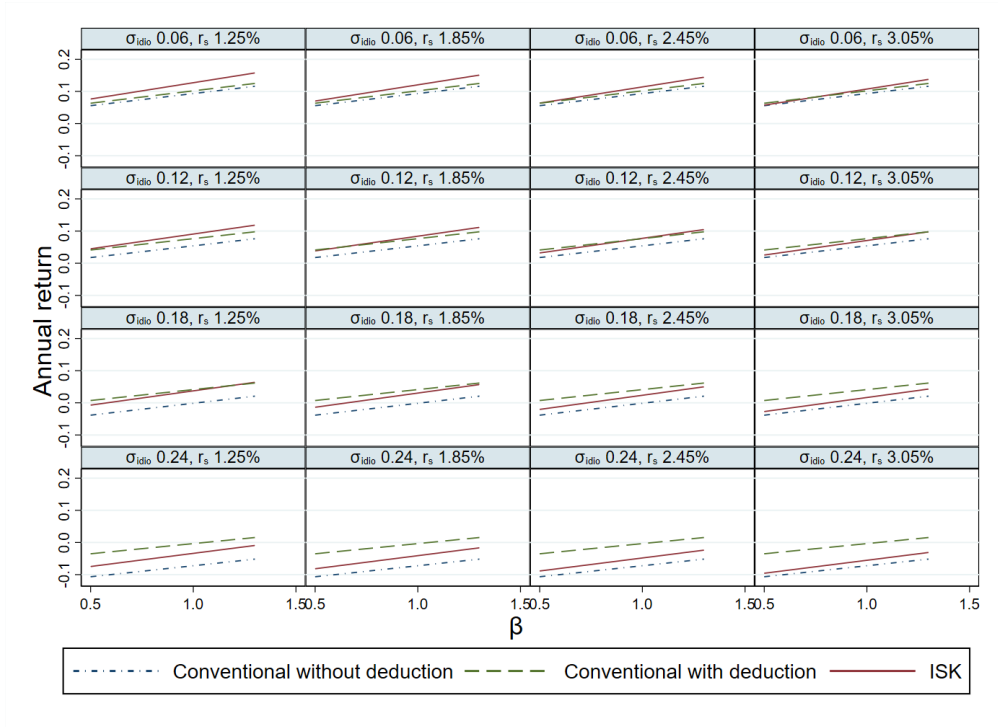


Figure 11: Return vs beta, horizon = 5 years

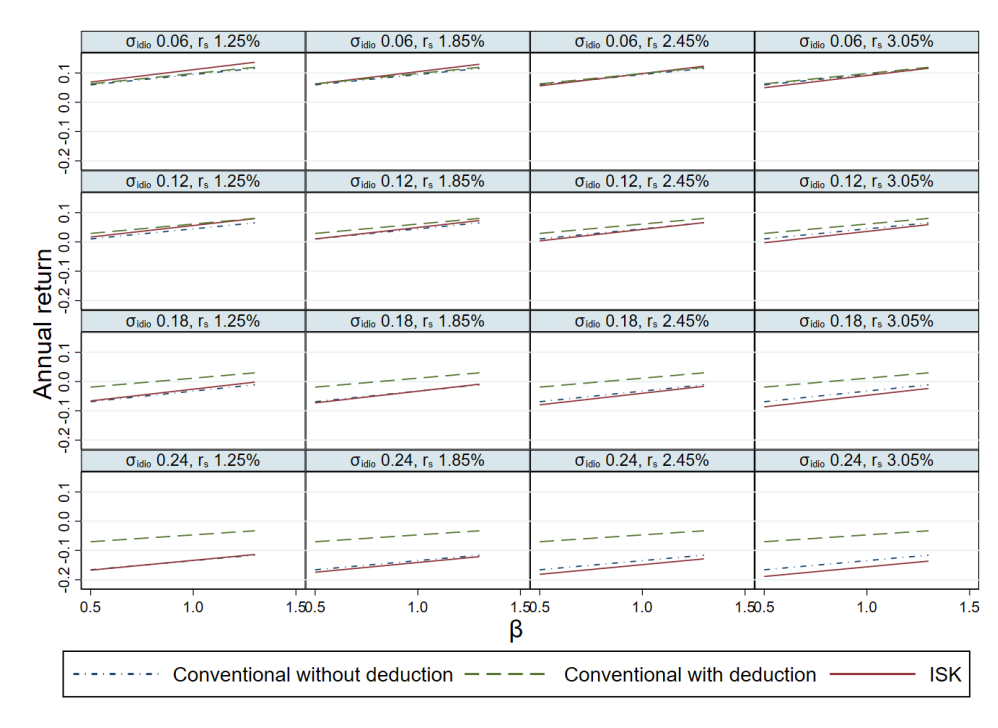


Figure 12: Return vs sigma, horizon = 1 year

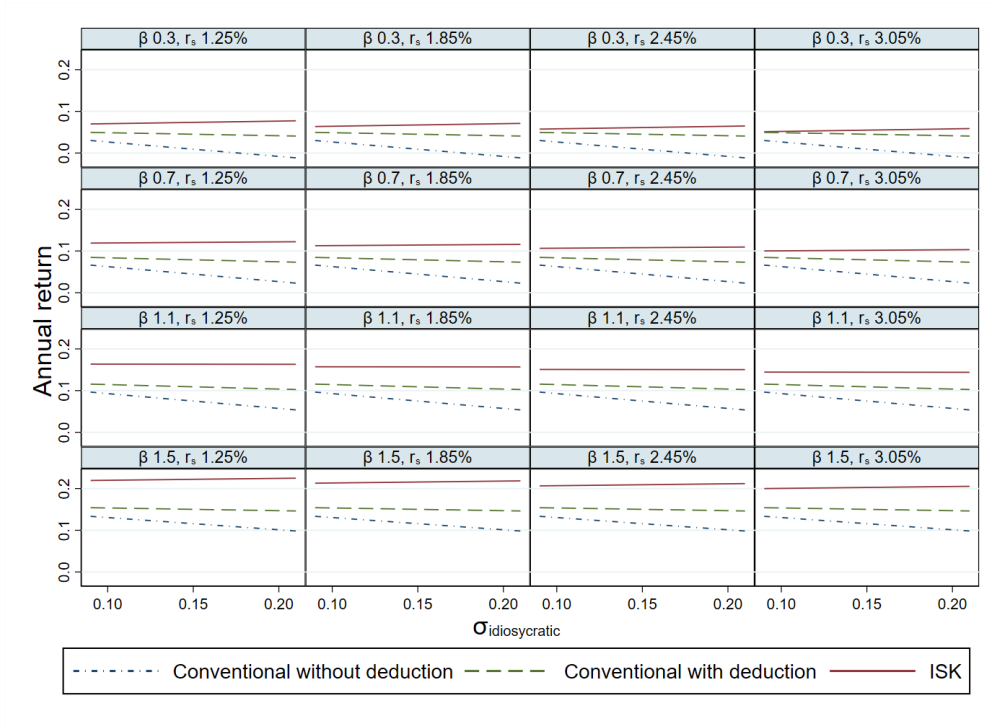


Figure 13: Return vs sigma, horizon = 2 years

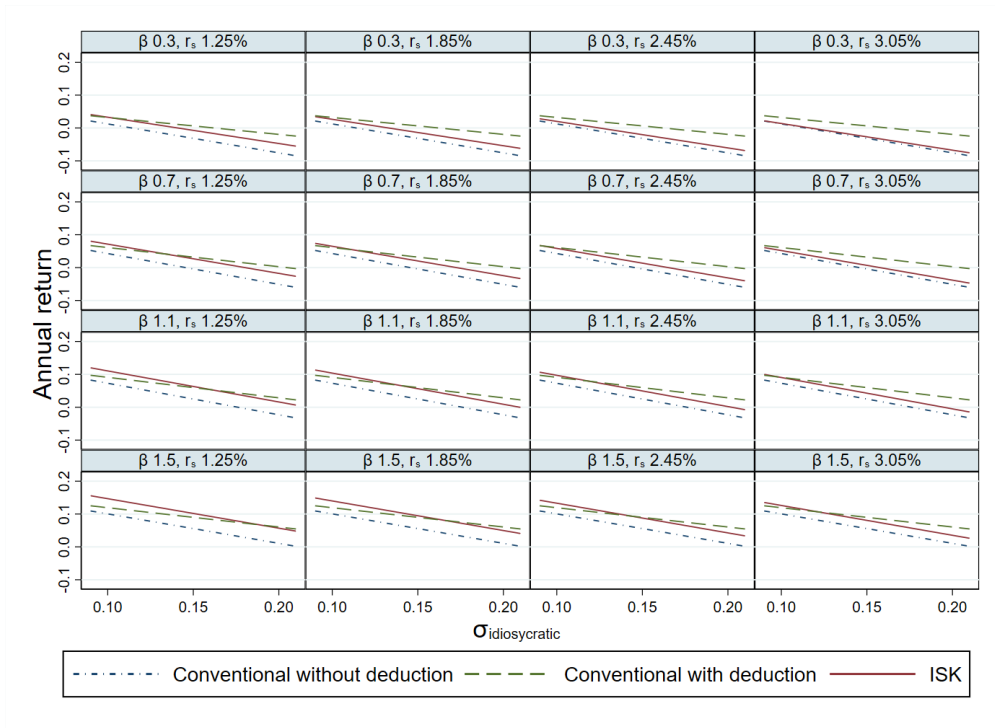


Figure 14: Return vs sigma, horizon = 5 years

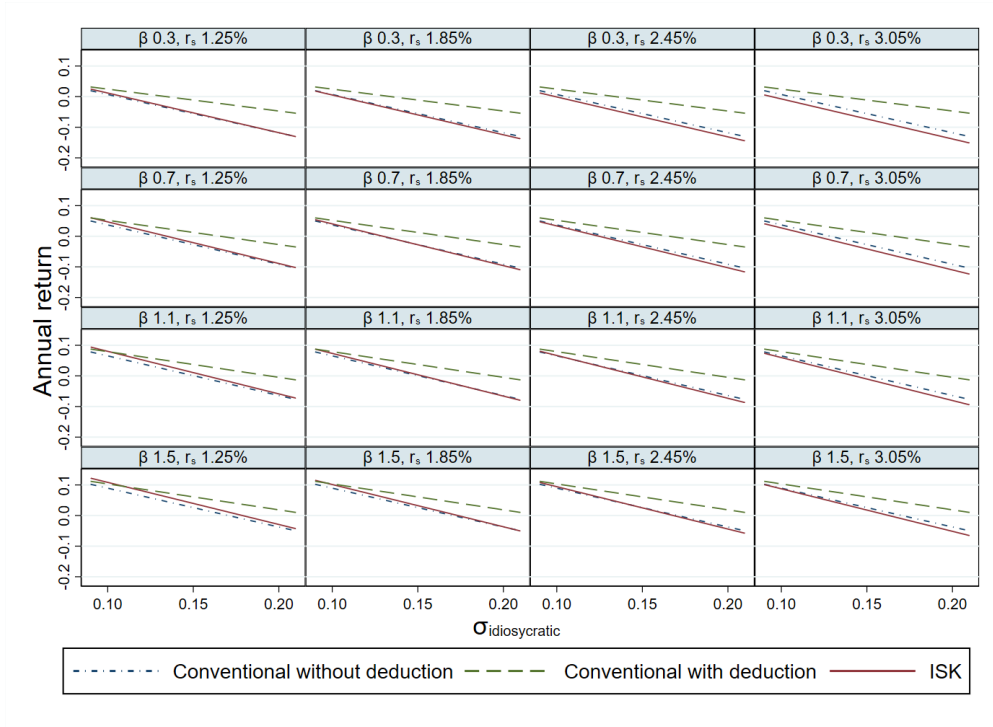


Figure 15: Return vs sigma, horizon = 10 years

