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Active Currency Management at the Swedish National Debt Office - A Case Study

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# Master Thesis Report

## Active Currency Management at the Swedish National Debt Office – A Case Study

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## Abstract

Swedish National Debt Office (SNDO) is responsible for managing Sweden's central government debt. Since the mid-1970s, SNDO has issued bonds in foreign currency in addition to Swedish Krona (SEK) debt, thereby incurring exposure to currency risk. Annually, the Swedish Parliament specifies the proportion of foreign currency and SEK debt, and allows SNDO to *tactically* trade a *portion* of the foreign currency liquidity to lower the costs of debt. This paper examines the *active currency management* at SNDO from 2002 to 2017, conducted by internal and external managers. It provides a detailed description of the approach, evaluates its strengths, and concludes that the practice has generated a return of SEK 1,360 million, or 0.29% of total debt servicing costs.

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## 1. Introduction

### 1.1. Thesis background

Swedish National Debt Office (SNDO), “Riksgäldskontoret”, is responsible for managing Sweden’s central government debt since the 18<sup>th</sup> century. In the late 1970s, the Swedish government allowed SNDO to issue bonds denominated in foreign currency to finance their borrowing requirement – the share of foreign currency debt was zero in 1975 and increased to over 30% in 1992. The predominant currency is USD while DM (now EUR), JPY, CHF and NLG (now EUR) were of limited use from 1970s to 1990s (De Fontenay, Milesi-Ferretti, & Pill, 1995, pp. 10c and 15). Foreign currency denominated debt may help the country to issue bonds with longer maturities than bonds issued in domestic markets. As a result, the strategy helps the borrowing nation avoid the risk of “bunching up” of redemption (De Fontenay et al., 1995, p. 6). Further, foreign markets with larger investor base are usually more liquid, hence, rollover or refinancing risk is lower in these markets.

However, borrowing in foreign markets exposes SNDO to risks such as interest rate risk, foreign currency risk, and counterparty risk (credit default risk). Since the late 1980s, SNDO has *actively managed* the foreign currency debt using derivatives such as foreign currency forwards (De Fontenay et al., 1995, p. 15). In fact, SNDO has been among the few debt offices in the world to perform *tactical trades* on the foreign currency debt portion. The tactical trading effectively changes the foreign currency exposure in relation to the strategic benchmark. In the study on the choice between domestic and foreign currency debt, De Fontenay et al. (1995, p. 16) provided the currency compositions of foreign public debt *before* and *after* debt management operations from 1981 to 1992, showing that the period from 1981 to 1989 saw almost the same share of currency proportions before and after the debt management operations, while the period from 1990 to 1992 presented significant percentages (table 1).

**Table 1: Currency composition of foreign public debt (percentage term) in Sweden from 1981 to 1992**

Year	USD	DM	CHF	NLG	JPY	Others
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**Excluding Debt Management Operations**

<b>1981</b>	60.54	14.02	9.80	2.05	6.03	7.51
<b>1982</b>	64.63	12.37	8.90	2.21	5.03	6.87
<b>1983</b>	68.26	9.82	7.28	1.95	5.37	7.32
<b>1984</b>	67.76	9.08	5.87	1.96	5.43	9.90
<b>1985</b>	59.44	13.70	8.68	3.65	6.76	7.76
<b>1986</b>	54.01	14.68	8.91	4.15	11.50	6.75
<b>1987</b>	49.60	13.97	8.47	4.22	15.29	8.44
<b>1988</b>	38.63	14.70	9.41	4.18	18.83	14.24
<b>1989</b>	29.49	16.93	8.38	4.69	16.97	23.54
<b>1990</b>	32.17	9.36	7.35	5.18	18.75	27.20
<b>1991</b>	30.24	8.78	7.53	5.03	18.42	29.99
<b>1992</b>	48.38	25.98	2.03	1.08	4.79	17.74

**Including Debt Management Operations**

<b>1981</b>	60.52	14.06	9.91	2.06	5.89	7.56
<b>1982</b>	63.79	12.40	9.85	2.22	4.84	6.90
<b>1983</b>	66.68	9.86	8.35	1.97	5.13	8.01
<b>1984</b>	65.02	9.17	7.95	1.98	5.27	10.60
<b>1985</b>	55.54	13.72	11.79	3.66	6.89	8.39
<b>1986</b>	50.44	12.84	14.29	4.94	9.78	7.73
<b>1987</b>	45.68	14.75	15.55	3.29	11.56	9.07
<b>1988</b>	38.42	12.51	17.22	2.07	13.19	16.58
<b>1989</b>	29.69	11.63	19.53	1.84	10.60	26.71
<b>1990</b>	17.05	10.35	20.00	1.29	7.24	44.07
<b>1991</b>	-4.08	21.37	2.79	8.37	-0.95	72.49
<b>1992</b>	12.89	32.22	0.16	3.85	0.11	50.77

*Source: De Fontenay et al., 1995, p. 16*

The risk associated with foreign currency positions, and how this can be effectively managed, both in terms of costs and benefits, is of interest of this thesis. Further, *active management* is common in asset management, but not among the managers of central government debt. This makes the case of SNDO particularly interesting. Active management is broadly understood as strategies using derivatives to exploit short-term market inefficiencies and to increase *alpha* (i.e. return) while maintaining the volatility within an acceptable range. These two factors, return and risk, are also of great importance in the management of central government debt at SNDO. The Swedish government clearly specifies that “*the overall objective of central government debt management is to minimize the long-term cost of the debt while taking into account the risks inherent in such management*” (Swedish National Debt Office, 2000, p. 1). This is even stated in the Swedish Budget Act (Budget Act, 2011, chapter 5, § 5).

Starting from 1992, SNDO engaged external debt managers together with their internal managers to actively manage foreign currency debt with the aims to (1) diversify the debt management strategies, (2) gain insights about different strategies, especially from the top asset management firms all over the world, and (3) create a performance benchmark for their internal management operations.

### ***1.2. Research objective***

This study focuses on (1) understanding ***how*** SNDO has actively managed the foreign currency risk by looking at their operation and performance from 2002 to 2017, (2) comparing and contrasting with the current academic literature on active management of foreign currency risk to see ***how differently*** SNDO has done, and (3) concluding ***whether*** this active management practice has been beneficial to the overall central government debt management. The study is aimed to help the authors gain a practical view and an in-depth understanding of this interesting active management strategy through real-world example. Further, the authors hope the findings in this research will be providing to the readers more background stories behind the Swedish government’s decisions to scale down the scope of active management, both internally and externally in 2018 following the reduction in foreign currency debt portion to only 5%. In fact, in early 2018, external managers were removed from the debt management operations, and only

one internal manager was left in charge of a mandate that is 10 times smaller than it was in the early 2000s.

The thesis is structured as follows. Section 1 outlines the background and research objective. Section 2 provides the history and description of the active management practice since it was initiated in 1992, with particular emphasis on the period from 2002 to 2017. The research covers the period from 2002 to 2017, and not from 1992 when the program started, due to the lack of publicly available data. Section 3 includes a summary of relevant theories and up-to-date research on hedging and active management of foreign currency. Section 4 follows with a detailed comparison between the practice adopted by SNDO and what the literature has proposed, and then a conclusion on the approach. Finally, research methodology and design as well as description of data and communication between the authors and SNDO are included in the appendices.



## 2. Active management of foreign currency debt

### 2.1. A brief history

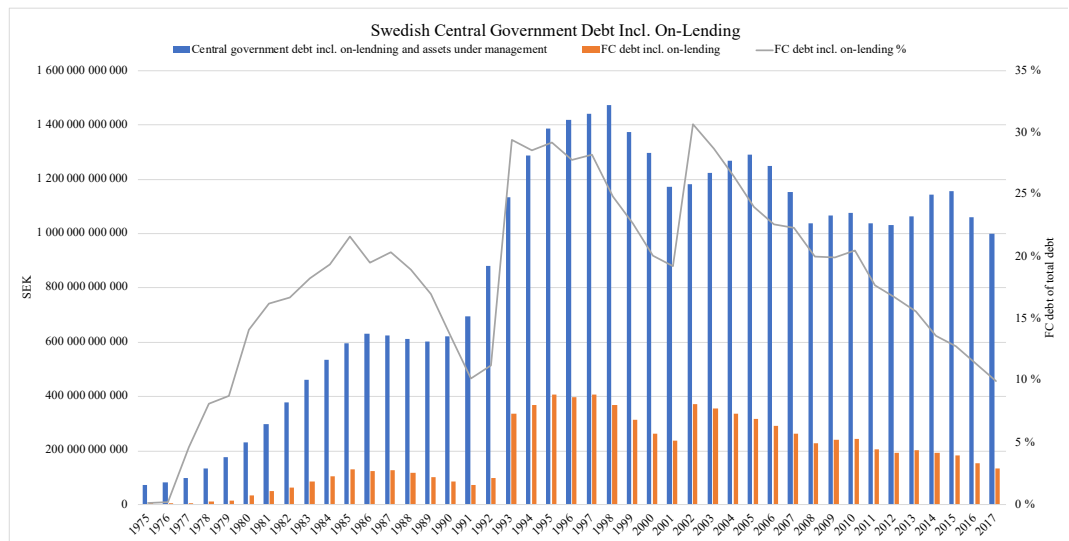
The management of the central government debt is handled by the Swedish National Debt Office (SNDO) since 1789. The aim is to minimize the long-term cost of debt while considering risks. In addition, the debt is to be managed within the framework of monetary policy (Budgetlag, 2011, Chapter 5, § 5). SNDO borrows money to fund budget deficits, based on the budget and borrowing requirement passed down by the Swedish Parliament (“Riksdagen”). There are three main types of debts: SEK nominal, inflation-linked and foreign currency bonds.

In 1818, about 75% of the central government debt consisted of foreign loans. Thereafter, Sweden’s portion of foreign debt varied – the debt was paid off, and Sweden even had foreign claims (Riksgälden, 2017a). Following investments in infrastructure in the early 1900s, the foreign currency debt rose. However, after the first world war, Sweden were able to buy back their loans at favorable prices from embattled countries and substituted them with nominal krona debt. These countries also needed to borrow money to rebuild their countries after five years of war, and Sweden became a *money exporting* country (Riksgälden, 2017b).

In 1970s, a sharp increase in oil prices led to an international recession, and the Swedish economy was destabilized. Sweden had to borrow abroad to finance its central government budget deficits. Due to poor central government finances between 1990 and 1994, the debt rose from 44% to 78% of GDP, from SEK 600 billion to SEK 1,300 billion (Riksgälden, 2017c). To limit pressure on the supply of government bonds in Sweden and the Swedish interest rate, a major portion of this debt was issued in foreign currency. As a result, the foreign currency debt portion of total central government debt grew from less than 10% to almost 30% from the late 1970s to 1992 (De Fontenay et al., 1995, p. 10c). However, from 1985 until 1991, the foreign currency portion dropped from roughly 21% to less than 10% (Swedish National Debt Office, 2000b, p. 34) due to “*valutalånenormen*”, or the “*Norm of Currency Borrowing*”, which was effective from the mid-1980s to 1992 prohibiting SNDO from carrying out *net borrowing* in foreign currency to cover budget deficits (Ministry of Finance, 1999, p. 8).

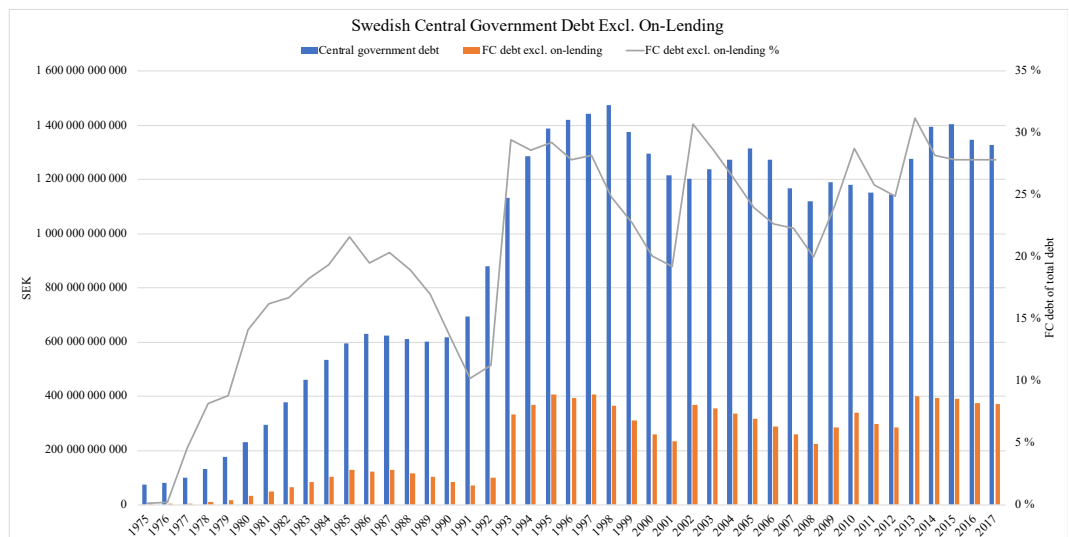
In 1992, the Norm was removed, and foreign currency debt portion increased back to approximately 30% and maintained the same rate until 2000. Simultaneously, in 1992, the Swedish government decided to remove SEK pegging to ECU (now EUR), and SEK became a floating currency. These two changes possibly motivated SNDO to start active management of the foreign currency debt, and the latter change is more important as it is one of the prerequisites for active currency management.

**Chart 1: Swedish Central Government Debt Including On-Lending**



Source: Publicly available data retrieved from [scb.se](http://scb.se) and [riksgalden.se](http://riksgalden.se)

**Chart 2: Swedish Central Government Debt Excluding On-Lending**



Source: Publicly available data retrieved from [scb.se](http://scb.se) and [riksgalden.se](http://riksgalden.se)

The external portfolio manager program was started in 1992 by the then-Director General with the main objective to create a yardstick for the performance

of the internal debt management operations. SNDO assigned a fictitious (nominal) portfolio of roughly 20% of total foreign currency debt to external managers, and closely monitored the positions taken by external managers, as well as compared their risk-adjusted returns with the internal managers'. However, the overall goal of central government borrowing, and the principles for how the debt was going to be managed, was set as late as in 1998, when the Parliament introduced new rules in the Act (1988:1387) on State Borrowing and Debt Management (Swedish National Debt Office, 1999, p. 3). Since then, guidelines for and evaluations of central government debt have been published annually, and the active management mandates for both internal and external managers have been updated and evolved as SNDO has been continuously learning from their successes as well as failures in the active management of the foreign currency debt. Given that the overall goal of central government debt, and the rules for how it was going to be managed, was set years after the active management of foreign currency debt had started, there is little written information about the active management operations prior to 1998. However, a government letter (Department of Finance, 1999, p. 31) concluded that the active management of foreign currency debt produced a positive result of SEK 5.3 billion in the years 1994/95-1998.

## ***2.2. Central government debt management***

### **2.2.1. Government's guidelines on central government debt management**

The guidelines for managing central government debt are produced by many parties in the government and was first introduced for the year 1999, after the Act (1988:1387) on State Borrowing and Debt Management was updated. The process requires SNDO's active participation in proposing the guidelines each year and submitting to the Riksbank (the Swedish Central Bank) by October 1<sup>st</sup> every year. The Riksbank will then give their comments on the proposal and send both the proposal and comments to the government for review and approval no later than October 22<sup>nd</sup> each year. The government will decide the guideline for the next year upon the proposals and comments from SNDO and the Riksbank by November 15<sup>th</sup>.

In the approved guidelines, some policies are decided by the government, whilst some are left for SNDO to decide on (see appendix 5 for details). The

former includes decisions on percentages of SEK debt, inflation-linked debt and foreign currency debt, how much of the foreign currency debt to be amortized during the year, as well as the maturity of the debt. In addition, the government decides the risk limit for position taking, with the main risk measurement being Value-at-Risk (VaR). Decisions made by SNDO can either be *strategic* or *operational*. Strategic decisions are made by the Board and include target currency composition of the foreign currency debt and *strategic positions*<sup>1</sup> in the SEK exchange rate. Operational decisions are taken by the management team and include issuance of the different kinds of debt and *position taking*<sup>2</sup> in foreign currencies and interest rates. The latter decision in foreign currency is called *active management* of foreign currency debt and is the main focus of this thesis.

### **2.2.2. Government's guidelines on evaluation of SNDO's performance of central government debt management**

In addition to the decision framework, the government also sets out the framework for the *performance evaluation* of SNDO's central government debt management. The main point in the evaluation guidelines is that the evaluation should be conducted on a quantitative basis, but where it is not possible, a qualitative approach shall be utilized. With the two main categories of decisions, the evaluation is conducted for the government's guidelines and SNDO's decisions and operation.

*Evaluation of government's guidelines* should be done directly against the long-term goal of central government debt management, which is lower cost with due consideration of the risks. The decisions made are assessed based on the risk appetite of the government, that is how much risk the government is willing to take on.

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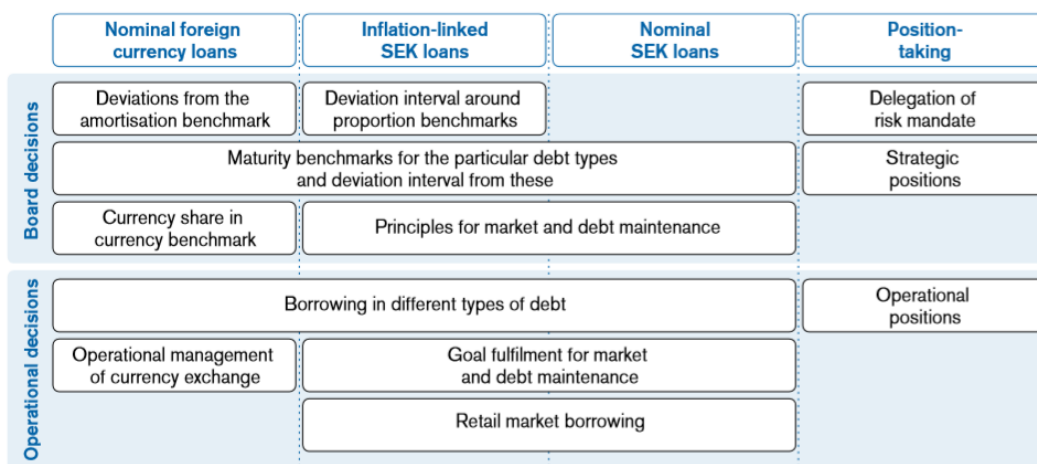
<sup>1</sup> **Strategic position** taking refers to the positions in the SEK exchange rate made by the Board under the assessment of the future value of the currency and its interest rate. The position is large, from SEK 7 billion to SEK 50 billion, and kept for a long-term period, usually more than one year. The position is taken in developed markets and is to be built up gradually and announced in advance.

<sup>2</sup> **Position taking** decisions made by SNDO's management team (i.e. the internal managers) are taken through derivative instruments for a much shorter period of time, usually less than one year. The positions can be taken in both foreign currencies and interest rates and both by internal and external managers.

*Evaluation of SNDO's decisions* are done separately for the strategic and operational decisions (see appendix 6 for details). For instance, strategic decisions on currency benchmark is evaluated qualitatively. So is also the delegation of risk mandate for position taking. Strategic positions in the SEK exchange rate, on the other hand, are measured in market value. For the operational decisions, the borrowing in and management of different types of debt are measured both qualitatively and on an ex-ante basis (i.e. forward looking) and quantitatively (e.g. cost comparison between borrowing in nominal SEK bonds and inflation-linked bonds over the last five years). Operational decisions on positions in interest rates and currencies (i.e. active management of foreign currency) are also evaluated.

### 2.2.3. Debt management framework

Following the decisions in the approved guidelines, SNDO establishes their operational decisions to guide the daily debt management process and “cover all spheres of activity at the Debt Office” (Swedish National Debt Office, 2006, p. 3) in their annual Financial and Risk Policy. The policy aims to provide (i) a process for risk management to “identify and proactively manage uncertain future events that can affect achievement of the Debt Office’s goals” (Swedish National Debt Office, 2006, p. 2) (see appendix 3), as well as (ii) a framework for borrowing and managing the debt as well as detailed mandate for each type of debt and operation. The latter framework can be illustrated as below:



Excerpt from the Government's Guidelines for Central Government Debt Management 2002

The groups of decisions in the chart above are updated year-on-year. However, the main principles over the years are on the same ground with the division of decisions into those made by the Board and SNDO's management.

*The Board* decides all the key *benchmarks* (debt portion and maturity) at the beginning of the year, including the amortization interval of foreign currency loans and inflation-linked loans. This ensures that SNDO would meet guidelines set out by the government at the beginning of the year, such as duration of the total debt portfolio and the pace of amortization of foreign debt (see appendix 5 for more details). However, there were a few cases where SNDO during the year decided to exceed the intervals due to the unexpected market movements. For example, in 2006, the Debt Office amortized an equivalent of SEK 18 billion of foreign currency debt, which was SEK 7 billion less than the target as per the government guidelines for that year. SNDO argued that the decision was a result of the abnormally weak SEK in the first six months of the year (Swedish National Debt Office, 2007, p. 10).

SNDO's *management team* makes *operational decisions*, including borrowing, currency exchanges, and debt market maintenance (which is essentially to create, maintain and develop an efficient and effective Swedish domestic debt market as well as maintain strong relationships with investors so the government can borrow easily and at lower cost).

One independent set of decisions on *position taking* which is of both the Board and the management team is set separately in the last group even though it is not a class of debt. Even though the two sets of decisions – strategic and operational decisions – have the similar nature (all taken through derivatives in well-developed and liquid markets) and motivations (lowering the cost while taking into account the risk), they are split into the Board's and management team's decision. This is due to its uniqueness in the *operational position decision* (or *tactical position taking decisions*) of the Swedish National Debt Office – that only very few debt offices around the world having similar practice.

The Board decides the *strategic positions* and the management team performs the daily various *tactical position taking* internally as well as manages the operations of the external portfolio managers. Whilst the former decisions by the Board effectively changes the currency benchmark when a position is taken because of the relatively large value of the position (over the years from 2002 to

2017, the mandate for strategic position was from SEK 7 – 50 billion), the latter done by the internal and external managers using a fictitious (i.e. nominal) portfolio does not directly affect the currency composition nor the debt structure of the whole portfolio. The approach is known as *overlay currency strategy*. See Literature Review in section 3 for more details on this strategy – a strategy widely used among international investors to exploit currency premium.

### 2.3. *Active currency management*

#### 2.3.1. **Borrowing in foreign currency**

The motivation for borrowing in foreign currencies includes diversification benefits, flexibility, and maintaining a strong SEK fixed income market (Swedish National Debt Office, 2011, p.15). Firstly, *diversification* reduces the risk of central government debt. The diversification benefits materialize when the borrowing requirement is high and SNDO can spread borrowing across different markets and investors. This enables the Debt Office to obtain the lowest possible cost of debt. Moreover, being diversified leaves SNDO less affected when the cost of a debt instrument is temporarily high. However, the diversification benefit applies only when SNDO has a foreign currency exposure. Secondly, foreign currency borrowing is *flexible* – if the state needs to borrow large amounts of money in short time, this is easily obtained in the global capital market. This reduces the financing risk. In addition, by issuing debt in the global capital market when the capital requirement is high, SNDO is prevented from increasing the auction volumes domestically. If they had to, the rates on the bonds in SEK would be higher. Therefore, by issuing debt in foreign currency, SNDO can *lower the pressure of bond rates for SEK bonds*, keeping the overall interest cost of debt down. For these reasons, even in years of budget surplus, SNDO still issue debt in some foreign currencies (often EUR and USD) to *establish the infrastructure of funding in global capital market* in case they should suddenly need to borrow large amounts of money in short time. The infrastructure covers, according to SNDO, “knowledge among employees, routines, systems, access to the investors, legal prerequisites concerning, for example, the necessary agreements and dealers.” (Swedish National Debt Office, 2013b, p. 11)

Foreign currency debt share means the *exposure*. One way to achieve the targeted exposure is to issue debt directly in foreign currency. An alternative way

is to use derivatives (swaps), together with a nominal SEK bond. The latter way has proved to be cheaper than the former by up to 66 basis points (Swedish National Debt Office, 2000a, p. 29). Further, the combination of SEK bond and swap also helps keep the domestic bond market liquid, which is also one of the goals in central government debt management – maintaining a liquid and strong SEK capital market.

### **2.3.2. Determination of foreign currency debt share in total debt portfolio**

Quantitative analyses in the beginning of the 2000s concluded that the greatest amount of risk reduction was achieved with a foreign currency debt share in the interval of 10-20%. Together with qualitative assessment, the foreign currency debt share was set to 15%, which was achieved in 2008 (Swedish National Debt Office, 2011b, p. 15). However, in the proposed guidelines for 2013, SNDO presented an analysis, required by the government back in 2010, of whether there is a *reduction in risk* in terms of cost variation by having a certain share of debt exposed to foreign currency. SNDO found that there is low cost variation of SEK debt, and that they have *not been able* to further reduce the cost variation by being exposed to other currencies (Swedish National Debt Office, 2012b, p. 1).

The year after, SNDO continued their analysis. The focus of this year was whether there is a *cost benefit* of having exposure to foreign currency in the strategic portfolio. SNDO concluded that the foreign currency debt share should be allowed to vary, because the cost benefit will change from time to time depending on market conditions. A ceiling of 15% was proposed (Swedish National Debt Office, 2013b, p. 1).

One year later, SNDO found no cost benefit of having a certain share of foreign currency, however, cost variation (risk) increases. Therefore, in the guidelines for 2015, SNDO proposed to have *no currency exposure* in the strategic benchmark, and that the foreign currency debt should be decreased by SEK 30 billion each year for the coming years. (Swedish National Debt Office, 2014, p. 1).

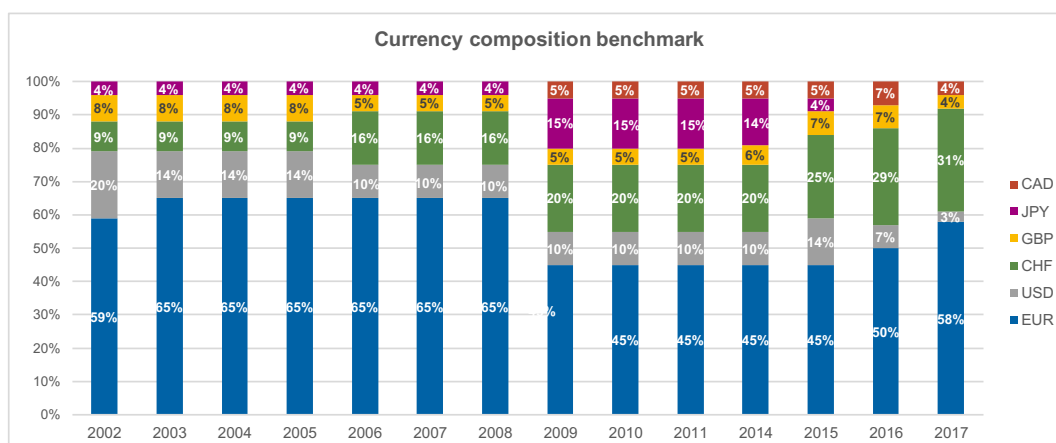


### 2.3.3. Determination of currency composition in foreign currency debt

A benchmark for currency composition in the foreign currency debt is constructed considering the largest and most liquid currencies. The benchmark is applicable for three years. In one of SNDO’s reports (Swedish National Debt Office, 2011a, p. 6-7), the approach for determining currency benchmark is explained. For instance, the benchmark constructed in 2008, applicable for years 2009-2011, was constructed in the following way:

- (i) A *risk-minimizing reference portfolio* was calculated by Black-Litterman method, using mean-variance optimization based on data from 1993-2008. This was the starting point for the benchmark. The reference portfolio consisted of EUR 83%, GBP 2%, CAD 1%, AUD 14%
- (ii) Thereafter, the benchmark was constructed in a *cost-minimizing way* while risks were taken into account. SNDO expected favorable interest rates in JPY and CHF and believed them to offset any strengthening of the currencies. Further, AUD was considered an expensive alternative to USD. The benchmark portfolio ended up as EUR 45%, USD 10%, CHF 20%, JPY 15%, GBP 5%, CAD 5%.

**Chart 3: Currency composition benchmark**



Source: SNDO’s annual reports and evaluation reports 2002-2017

As can be seen from the above chart, after the decision in 2015 to gradually decrease foreign currency exposure from a fixed percentage of 15%, the exposure to each currency fluctuates from year to year.

### 2.3.4. Active currency management

#### 2.3.4.1. Active currency management or Position taking

Active currency management is done through *position taking* at SNDO, aiming at (1) *reducing the costs* of the central government debt while taking account of risk, and/or (2) *reducing the risks* for the central government debt while taking into account cost (Ministry of Finance, 2016, p. 8). Positions are taken in interest rates and currencies and are not motivated by underlying borrowing requirements. There are two main decisions in position taking; (1) *strategic/special position taking* (or positions taken in the *SEK exchange rate*) and (2) *active management* (or positions taken in *foreign currency*). Both positions are to be created through liquid and/or well-established derivatives instruments, and not to be taken in Swedish fixed income market. However, since 2010, strategic positions need not be taken in derivatives instruments (Ministry of Finance, 2009, p.14). The goal is to create a positive return on the positions while not exceeding the risk limits. The former is decided by SNDO's Board based on long-term views about the market while the latter is handled by both internal and external managers based on short-term views about future interest rates and exchange rates. The latter is called *active management of foreign currency debt* (or active management for short) at SNDO.

Active management is based on relative value or mispricing in the interest rate and foreign exchange. The management has no assets (nor debts) and is fully based on derivatives. The managers watch the market prices of different financial instruments (*technical trading*), in addition to macroeconomic and political development (*fundamental strategy*). Each manager is responsible for making the necessary analyses on individual positions as well as the whole tactical portfolio (fictitious). This is also supported by the Debt Management Department as well as Department of Analysis and Development. In addition to their own analyses, internal managers may also use external managers' analyses if they believe this would help produce a better risk-adjusted return.

From 2014 SNDO no longer distinguish between strategic and operational positions, but instead call them positions. This change was proposed because of the previous wording was confusing, i.e. both *strategic* and *operational* positions are part of the *tactical* portfolio, not the *strategic*. Some of the positions still have to be decided by the Board, and the Board also decides how much are allocated to day-to-day management. However, for the sake of explaining their characteristics,

in the following we will continue to distinguish between strategic positions and active management in the tactical portfolio.

#### 2.3.4.2. Risk management

The main risk measure of position taking is daily *Value-at-Risk* (VaR), where the total VaR of both *strategic* and *active* positions must be lower than a certain limit set out by the government. However, the *strategic* positions are exempt from the limit in terms of VaR since 2010 (Ministry of Finance, 2009, p.14). The specific limit established for *active* positions are determined by SNDO and is monitored by the Debt Management Department.

VaR measure is calculated for one-day period (daily VaR) at 95% confidence interval. The VaR calculation at SNDO is developed by JP Morgan considering volatilities and correlations of identified risk factors each year, including (1) currencies, and (2) maturity intervals.<sup>3</sup> See appendix 4 for detailed steps on VaR calculation at SNDO. In addition, SNDO employs a risk-adjusted return measure called *information ratio*, which is calculated by dividing return by volatility of the returns.

The total VaR limit for foreign currency positions within the active management is roughly SEK 300 – SEK 600 million and is set by the Government every year. The Board of SNDO decides how much of the limit to be allocated to the ongoing management. The limit for foreign currency positions during the study period is roughly SEK 220 million. The Director General then decides how much to be used in the ongoing management. The amount is usually much lower, depending on the risk appetite of the Director.

In addition to VaR, operational mandate - which applies for both internal and external portfolio managers – also includes limitations in terms of portfolio size and permitted markets. *Portfolio size*, which is specified for both internal and external managers, is SEK 200 billion in total. Of this amount, a maximum of SEK 40 billion, or roughly 20% of total active portfolio, is allocated to external managers. *Permitted markets* are markets with liquid and well-developed derivative instruments, including AUD, CAD, CHF, DKK, EUR, UK, JPY, NOK

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<sup>3</sup> As per 2018 Financial and Risk policy, VaR in 2018 is calculated based on 152 factors, which are from (1) 8 currencies that are allowed for active management, and (2) 18 maturity intervals.

and USD markets. In addition, there are *limits on currency positions* in percentage terms of the total amount actively managed (i.e. assigned portfolio), *limits on interest rate positions* affecting *total duration* of the amount under active management, and limits on interest rate positions in individual currencies affecting the *duration in individual currencies*. Still, overall portfolio consideration is a dominant feature in the investment process. See table 2 in the following page for more details on the specific mandates each year from 2002 to 2017. The mandates have changed over the years due to varying market conditions – see appendix 7 for explanations of the changes in each year.

*Time perspective* of an *active position* varies, from a few weeks up until one year. Positions that are longer than one year are subject to Board's decision, and are called *strategic positions*. However, SNDO is responsible for identifying such opportunities when they arise and proposing them to the Board.

*Return* of the active management is measured as (1) the change in market value of the portfolios (including accrued interest rates) and (2) realized cash flows. The results are presented annually, however, emphasis is put on the results over the latest five-year period.

As for *reporting*, each external manager's transactions, as well as the internal management's, are placed in separate portfolios and evaluation of risks and results are done for each portfolio/manager. Furthermore, return and outstanding positions in the active foreign currency management, significant deviations from the risk mandate and results of back-testing of the VaR model are reported to the Board on a running basis.

**Table 2: Mandates given to internal and external managers from 2002-2017**

Source: Financial and Risk Policy 2006-2017

Note: N/a: Not available – lack of data available

	<b>Government’s decisions</b>			<b>Position taken in SEK exchange rates (long-term)</b>	<b>Portfolio for active management (positions taken in foreign currency)</b>		<b>Risk management</b>		
	<b>FC debt amortization</b>	<b>FC debt %</b>	<b>Duration/ Interest re-fixing period</b>		<b>Total</b>	<b>Allocated to external managers</b>	<b>Risk position (or VaR)</b>	<b>Position limit in an individual currency</b>	<b>Impact on duration from interest rate positions</b>
2002	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a
2003	N/a	N/a	N/a	N/a	N/a	SEK30B in total	SEK220M	<= 6% of the managed debt amount	<= 0.4 years for each individual

									currency ≤ 0.6 years for the whole portfolio
2004	SEK25B	N/a	N/a	N/a	N/a	SEK6B allocated to each manager (3-6 managers were used during the year)	N/a	N/a	N/a
2005	SEK25B	15%	N/a	N/a	N/a	N/a	N/a	N/a	N/a
2006	Government decision: SEK25B ±15B SNDO decision: SEK10B	15%	2.1 years	N/a	SEK200B	Maximum SEK40B, of which SEK6B- SEK8B allocated to each manager	<b>Internal management:</b> SEK220M minus amount allocated to external managers <b>External management:</b> 20% (or SEK44M) of total VaR limit, of which	± 6% of SEK200B	± 0.6 years for each particular currency ± 0.9 years for total portfolio

							maximum 4% (or SEK8.8M) of total VaR limit allocated to each manager		
2007	SEK40B	15%	0.125	N/a	SEK200B	Maximum SEK40B, of which SEK6B-SEK8B allocated to each manager	<b>Positions in foreign currency:</b> SEK600M <b>Internal management:</b> SEK220M minus amount allocated to external managers <b>External management:</b> 20% (or SEK44M) of total VaR limit, of which maximum 4% (or SEK8.8M) of total VaR limit allocated to each manager	± 6% of SEK200B	± 0.6 years for each particular currency ± 0.9 years for total portfolio
2008	SEK40B	15%	0.125	N/a	SEK200B	Maximum	<b>Positions in foreign</b>	± 6% of	± 0.6% of

						SEK40B, of which SEK6B-SEK8B allocated to each manager	<b>currency:</b> SEK600M <b>Internal management:</b> SEK220M minus amount allocated to external managers <b>External management:</b> 20% (or SEK44M) of total VaR limit, of which maximum 4% (or SEK8.8M) of total VaR limit allocated to each manager	SEK200B	portfolio size for each individual currency $\pm$ 0.9% of whole portfolio
2009	SEK20B	15%	0.125	SEK15B/SEK50B	SEK200B	Maximum SEK40B, of which SEK6B-SEK8B allocated to each manager	<b>Positions in foreign currency:</b> SEK600M <b>Internal management:</b> SEK220M minus amount allocated to external managers	$\pm$ 6% of SEK200B	$\pm$ 0.6 years for each particular currency $\pm$ 0.9 years for total



							<b>External management:</b> 20% (or SEK44M) of total VaR limit		portfolio
2010	SEK20B	15%	0.125	SEK50B	SEK200B	Maximum SEK40B, of which SEK6B-SEK8B allocated to each manager	<b>Positions in foreign currency:</b> SEK600M <b>Internal management:</b> SEK220M minus amount allocated to external managers <b>External management:</b> 20% (or SEK44M) of total VaR limit	± 6% of SEK200B	± 0.6 years for each particular currency ± 0.9 years for total portfolio
2011	SEK20B	15%	0.125	SEK50B	SEK200B	Maximum SEK40B, of which SEK6B-SEK8B allocated to each manager	<b>Positions in foreign currency:</b> SEK450M <b>Internal management:</b> SEK220M minus amount allocated to external managers	± 6% of SEK200B	± 0.6 years for each particular currency ± 0.9 years for total

							<b>External management:</b> 20% (or SEK44M) of total VaR limit		portfolio
2012	SEK20B	15%	0.125	SEK15B	SEK200B	Maximum SEK40B, of which SEK6B-SEK8B allocated to each manager	<b>Positions in foreign currency:</b> SEK450M <b>Internal management:</b> SEK220M minus amount allocated to external managers <b>External management:</b> 20% (or SEK44M) of total VaR limit	± 6% of SEK200B	± 0.6 years for each particular currency ± 0.9 years for total portfolio
2013	SEK20B	15%	0.125	SEK7.5B	SEK200B	Maximum SEK40B, of which SEK6B-SEK8B allocated to each manager	<b>Positions in foreign currency:</b> SEK450M <b>Internal management:</b> SEK220M minus amount allocated to external managers	± 6% of SEK200B	± 0.6 years for each particular currency ± 0.9 years for total

							<b>External management:</b> 20% (or SEK44M) of total VaR limit		portfolio
2014	SEK20B	15%	0.125	SEK7.5B	SEK200B	Maximum SEK40B, of which maximum SEK8B allocated to each manager	<b>Positions in foreign currency:</b> SEK300M <b>Internal management:</b> SEK220M minus amount allocated to external managers <b>External management:</b> 20% (or SEK44M) of total VaR limit	± 6% of SEK200B	± 0.6 years for each particular currency ± 0.9 years for total portfolio
2015	SEK30B <sup>4</sup>	15%	0-1 years	SEK7.5B	SEK200B	Maximum SEK40B, of which maximum	<b>Positions in foreign currency:</b> SEK300M <b>Allocated to Internal running management:</b>	6% of notional portfolio	±0.6 years for each individual currency

<sup>4</sup> In 2015, there was a change in the steering of foreign currency debt to a lower share of foreign currency debt due to lack of evidence that foreign currency debt is cheaper than SEK loans. Therefore, larger amortization pace of foreign currency debt (SEK30B vs. SEK20B in previous years) was decided to be effective for 2015.

						SEK8B allocated to each manager	SEK220M minus amount allocated to external managers <b>Allocated to external management:</b> 20% of total active management VaR limit, i.e. SEK44M daily.		± 0.9 years for the whole portfolio
2016	Maximum SEK30B	15%	0-1 years	SEK7.5B	SEK200B	Maximum SEK40B, of which maximum SEK8B allocated to each manager	<b>Positions in foreign currency:</b> SEK300M <b>Allocated to Internal running management:</b> SEK220M minus amount allocated to external managers <b>Allocated to external management:</b> 20% of total active management	± 6% of notional portfolio	± 0.6 years for each individual currency ± 0.9 years for the whole portfolio

							VaR limit, i.e. SEK44M daily.		
2017	Maximum SEK30B	15%	0-1 years	SEK7.5B	SEK200B	Maximum SEK40B, of which maximum SEK8B allocated to each manager	<p><b>Positions in foreign currency: SEK300M</b></p> <p><b>Allocated to Internal running management: SEK220M</b> minus amount allocated to external managers</p> <p><b>Allocated to external management: 20%</b> of total active management VaR limit, i.e. SEK44M daily.</p>	± 6% notional portfolio	± 0.6 years for each individual currency ± 0.9 years for the whole portfolio

### 2.3.4.3. External portfolio managers

#### 2.3.4.3.1. *Why engage external managers?*

The purposes of having external managers include “*to functioning as a diversification of active management*”, and the possibility that “[*external managers*] should contribute to the transfer of knowledge and information. This primarily takes place through our daily insight into the managers’ individual and combined positions.” (Swedish National Debt Office, 2012a, p. 16) This was further corroborated the next year: “*In addition to the continuous evaluation of the position-taking, we have had regular meetings and telephone conferences with the managers. This regular contact increases understanding of the various management processes and occasionally produces ideas that can also be used in the internal management*” (Swedish National Debt Office, 2013a, p. 17)

External managers’ results and performance also work as a benchmark for which the internal management at SNDO can compare their own performance. Further, diversifying external managers is of great importance to SNDO because it lowers the risk in the active management. The Debt Office engages external managers with different management styles, strategies and approaches, and the managers are positioned in different countries.

#### 2.3.4.3.2. *Selection of external managers*

To compare the results of external managers and the internal management, the managers hired should be given the opportunity of long-term management and should therefore work for SNDO for a time period of at least three years (Swedish National Debt Office, 2006, p. 9).

For a manager to be hired, the candidate should be experienced with a mandate like that of SNDO and with management of global currency- and interest rate funds. The candidate should have a well-known name, e.g. be connected to a large international bank. When considering a candidate, the possibility of generating good results should be considered. Historical returns relative to risk is an important factor. In addition, the manager’s status with regards to e.g. mergers and purchases should be considered, because such events might reduce the information value of historical performance. Its profile with respect to strategies, decision processes and risk models is also taken into account. The manager must accept SNDO’s methods for reporting results and risk. In addition, if the managers

enter into transactions themselves, they should be under supervision by a supervisory authority in its role as manager and have a good organization with well-established routines and a robust system that lives up to SNDO's instructions for internal control. In addition to that, the managers should have a huge track record, i.e. its customers shall be satisfied, and they should have well-established routines for verifying compliance with the principle of duality. Finally, the managers should have a strong financial position and insurance against damage claims from customers (Swedish National Debt Office, 2006, p. 9).

An external manager can be fired due to poor results, disrespect of limits and/ or poor reporting of results and communication. Huge losses and/or serious limit exceedance should result in the manager being fired before three years have passed (Swedish National Debt Office, 2006, p. 9).

#### 2.3.4.3.3. *Fees to external managers*

External managers are compensated in according to a fee structure consisting of (1) an annual *fixed* fee (3 basis points) over the assigned amount which is usually SEK 6 – 8 billion to each manager and (2) a *variable* fee calculated based on a fixed percent of the excessive return. For example, since 2012, the variable fee paid to external managers have been 20% of return exceeding 20 basis points. See appendix 8 for the fee scheme applied from 2001 – 2017.

A maximum of SEK 40 billion is assigned to the external managers each year; thus, a maximum fixed fee of SEK 12 million is paid to the external managers annually. According to SNDO, a reasonable objective is for a manager to deliver a result of 20 – 75 basis points. Therefore, with the most recent fee structure, a manager assigned with a notional portfolio amount of SEK 6 billion will receive SEK 1.8 million in fixed fee plus SEK 0 – 6.6 million in variable fee. A manager assigned with SEK 8 billion will in total receive SEK 2.4 million in fixed fee plus a variable fee of SEK 0 – 8.8 million (Appelgren, 2014, p. 37).

Time and resources allocated for active management of foreign currency debt have decreased over the years, as a natural response to the decreasing foreign currency debt in the central government debt portfolio. During the “external management program” at least four full-time managers were engaged in the internal management, with support from people working within risk and jurisdiction etc. Minimum three and maximum six external managers were engaged during the period. Today (2019), there are three managers left in the

internal management, all of them with a 20% position allocated to active management (60% in total). The “external management program” was ended in 2018, and no external managers are engaged at this point.

#### 2.4. Historical performance of active management

In the Evaluation of Swedish National Debt Office’s borrowing and foreign currency debt for budget years 1994/95 – 1998 (Ministry of Finance, 1999), the Parliament confirms that active management at SNDO during the five-year period led to a positive result of SEK 5.3 billion. In addition, the evaluation states that the internal management outperformed the external managers, with a lower portion of risk taken on by the internal management. The following tables show the total result of both internal and external managers, as well as their information ratio, i.e. the risk-adjusted return.

**Table 3: Results of internal and external managers (SEK million)**

Year (SEKm)	External managers				Internal managers				Total result (net of fee)
	Gross result	Fee	Net result	Average portfolio size	Interest positions	Currency positions	Total result	Average portfolio size	
1995/96					2,352	2,316	4,668		
1997					(97)	13	(84)		
1998					611	(41)	570		
1999					65	(571)	(506)		
2000					110	714	824		
2001					83	(161)	(78)		
2002	43.18	11.59	31.58	30,000	(78)	470	392	356,364	424
2003	58.84	10.80	48.03	26,434	224	656	880	170,000	928
2004	29.13	11.28	17.85	34,980	(18)	182	164	159,333	182
2005	7.99	10.89	(2.91)	33,344	187	(613)	(426)	166,000	(429)
2006	(16.62)	11.19	(27.81)	32,805	367	(19)	348	165,500	320
2007	(28.03)	10.95	(38.98)	32,000	(241)	38	(203)	162,000	(242)
2008	191.30	55.65	135.65	30,286	44	261	305	170,000	441
2009	84.39	18.89	65.49	28,486			424	165,333	489
2010	263.98	54.04	209.93	30,814			(587)	167,000	(377)
2011	(1.28)	9.00	(10.28)	30,000			(151)	163,000	(161)
2012	(23.85)	13.12	(36.97)	25,632			(185)	165,000	(222)
2013	(35.22)	11.20	(46.42)	34,512			235	156,000	189
2014	90.50	44.01	46.49	36,000			(125)	139,000	(79)
2015	44.26	24.79	19.47	36,000			(47)	64,000	(28)
2016	43.55	16.03	27.52	36,000			(1)	64,000	27
2017	(104.00)	11.00	(115.00)	36,000			13	15,000	(102)
<b>Total from 2002-2017</b>									1,360

Source: Publicly available annual reports and evaluation reports on riksgalden.se, and data provided by SNDO during the course of the thesis

Note: Highlighted area in grey indicates lack of data.



**Table 4: Information ratio for internal and external managers**

Year <i>(basis points)</i>	External managers				Internal managers			Aggregate information ratio
	Interest positions	Currency positions	Gross result	Net result	Interest positions	Currency positions	Total result	
1992	23	23	46		20	20	40	pos.
1993	51	51	102		212	112	324	pos.
1994	(46)	(31)	(77)		(37)	(23)	(60)	neg.
1995	36	(40)	(4)		58	(7)	51	pos.
1996	1	26	27		19	18	37	pos.
1997	13	1	14		(5)	3	(2)	neg.
1998	20	(39)	(19)		19	(5)	14	pos.
1999	(29)	(5)	(34)		(1)	(15)	(16)	neg.
2000	2	14	16		3	(19)	(16)	neg.
2001	(4)	(8)	(12)		2	(4)	(2)	neg.
2002	0	14	14	11	(2)	13	11	pos.
2003	0	14	14	18	13	38	51	pos.
2004			8	5	(1)	12	11	pos.
2005			2	(1)			(26)	neg.
2006			(5)	(8)			21	pos.
2007			(9)	(12)			(13)	neg.
2008			63	45			18	pos.
2009			30	23			26	pos.
2010			86	68			(35)	neg.
2011			(0)	(3)			(9)	neg.
2012			(9)	(14)			(11)	neg.
2013			(10)	(13)			15	pos.
2014			25	13			(9)	neg.
2015			12	5			(7)	neg.
2016			12	8			(0)	neg.
2017			(29)	(32)			9	pos.
<b>Total from 2002-2017</b>			<b>204</b>	<b>111</b>			<b>51</b>	
<b>Total from 1992-2017</b>			<b>263</b>				<b>421</b>	

Source: Publicly available annual reports and evaluation reports on riksgalden.se, and data provided by SNDO during the course of the thesis

Note: Highlighted area in grey indicates lack of data.

As can be seen from table 3, aggregated result of both internal and external managers totalled SEK 1,360 million for the years 2002-2017. Year 2003, 2008 and 2009 were among the best years, while 2005 and 2010 were among the years with largest losses. The table also show the annual fees paid to external managers, which for years 2008 and 2010 exceeded SEK 50 million, and SEK 40 million in 2014. In 2005, the positive result generated by the external managers was completely “eaten up” by fees, resulting in a negative result for the external management. Table 4 shows the information ratio for both internal and external managers over the years. The information ratio is calculated as the return divided by its standard deviation and is a measurement for the risk-adjusted return. The

results have varied significantly over the years and between the internal and external managers. This also applies to the results of interest rate and currency positions. For a more detailed description of market conditions and gains and losses from interest rate and currency positions from 2002 to 2017, see appendix 9.

In general, positions taken in the 1990's up until 2008 were more long term than in recent years, usually with maturities ranging between 6 months – 1 year. The market was characterized by high volatility, low transparency, good macro views and possibilities for tactical positions. External managers following macro strategies were well suited for this kind of environment and did better in general. However, in the aftermath of the financial crisis of 2008-2009, when central banks lowered the interest rates, it became harder to follow macro strategies and more difficult to beat the market in general. Since then, market has been characterized by low volatility and high transparency. The rates have stayed low for a decade and calls for short-term positions, with maturities usually ranging between 1 month – 6 months. In general, managers following systematic strategies have been more successful in recent years.

### 3. Literature review

Currency risk arises in portfolios where the base currency of the investors is different from that of the component assets. The risk is decided to be hedged or unhedged depending on its impact to the overall portfolio's return. *Optimal currency hedging* theory, which is developed based on Markowitz's *mean-variance framework*, provides international investors the *optimal hedging ratio* for different currency in both stock and bond portfolios. In addition to mean-variance approach, Duarte and Rajagopal (1999) propose scenario-based optimization models which allow more flexibility for forecast inputs and extreme events compared to the average estimates in the former approach.

*Optimal currency hedging theory* is popular among investors for its systematic and quantitative approach taking into account both risk and return of the portfolio. The theory considers currency as a separate source of return rather than being inherently part of the component individual foreign asset, thus the decision and choice over each currency is essentially an *asset allocation decision*, which is the backbone of modern portfolio theory. Accordingly, there are three main components in an asset allocation framework – asset allocation policy, active asset allocation, and security selection. Decision on *asset allocation policy* involves the establishment of *normal asset class weights* and is an integrated part of the investment policy. Meanwhile, *active asset allocation* decisions happen during the process of *managing asset class weights relative to the normal weights*. The goal of active asset allocation is to either (i) enhance the returns or (ii) lower the risk. In other words, the portfolio's risk/return trade-off (Brinson, Singer, & Beehower, 1991, p. 40). Currency hedging theory is also developed on the similar grounds of asset allocation, with currency composition benchmark as an asset allocation policy and active currency management as the management of the actual weights relative to the benchmark with the goal to increase return from the currency while considering the risk.

*Optimal currency hedging ratio* developed by mean-variance framework suggests different currency hedging strategies, including no hedge, unitary (full) and universal hedging, which will be discussed in detailed in the following paragraphs.

### 3.1. Asset allocation

#### 3.1.1. Domestic dimensions

Modern portfolio theory is built upon the capital asset pricing model (CAPM), which was developed in the early 1960s by Treynor (1961 and 1962), Sharpe (1964), and later Lintner (1965) and Mossin (1966). The model was based on Markowitz's earlier discovery of the efficient frontier in his paper on efficient diversification in investments in 1959. Accordingly, the efficient frontier is the set of combinations of securities which either (1) maximize the portfolio's return given a certain level of risk or (2) minimize the portfolio's risk for a given level of return. From there, the mean-variance optimization is formulated with (i) a global minimum-variance portfolio to ensure the portfolio is at its lowest risk possible and (ii) tangency portfolio to maximize the portfolio's return. The mean-variance portfolio choice is based on the important assumptions on investors' goal (to maximize expected utility), their utility functions (quadratic) and the assumed distribution of asset returns (over normally distributed) (Jorion & Khoury, 1996, p. 249).

CAPM is developed based on five main assumptions (Jorion & Khoury 1996), including the above-mentioned assumptions of mean-variance portfolio choice, as well as the assumption that securities markets are in equilibrium, i.e. the demand for optimal assets is the same as the supply of assets, which is fixed in the market. Further, risk-free assets are available for borrowing and lending. In addition, capital markets are assumed to be "perfect", that is, no frictions, short sales are allowed, and investors are price takers. Finally, investors are assumed to have homogeneous expectations about the distribution of rates of return. However, this does not necessarily have to be true in international markets where investors use different currencies to measure asset values and consider factors that are locally applied.

The most important contribution of CAPM theory is the marginal contribution of change in a component asset to portfolio's overall risk. Such marginal contribution is defined as beta of an asset ( $\beta$ ) and is measured by the following mathematical formula:

$$\beta_{iM} = \frac{\rho_{iM}\sigma_i\sigma_M}{\sigma_M^2} = \frac{\rho_{iM}\sigma_i}{\sigma_M}$$

in which  $\beta_{iM}$  measures the *extra* risk that security  $i$  adds to the portfolio.  $\beta_{iM}$  is also the slope of the security market line of security  $i$ . Hence, overall risk of the portfolio would *increase* or *decrease* by an exact amount by  $\beta_{iM}$  depending on whether the security returns *positively* or *negatively correlate* with the portfolio returns.

### 3.1.2. International dimensions

Investors diversify first for lower *risk*, which is driven by *correlation* among stocks. Solnik (1974) was among the first ones to show such benefits when he studied the volatilities of randomly chosen US-stocks-only portfolios and those made of both US and foreign stocks. His results showed that both portfolios' risk would asymptotically converge to a lower limit as the number of stocks increased. However, for the mixed portfolio, the lower limit is only half of that of the pure US stock portfolio. Further, Jorion and Khoury (1996) studied the different combination of stocks from different countries to see the correlation level of stock returns between different pairs of countries. Using the data on correlations of annual returns of national stock markets (converted to USD) of 10 countries (Australia, Canada, France, Germany, Italy, Japan, Netherlands, Switzerland, UK and US) from 1970 to 1989, Jorion and Khoury found that the lowest correlation level is 0.10 (Canada and Germany) and the highest is 0.84 (Netherlands and Switzerland), after excluding the assuming correlation of 1 for stocks of the domestic markets. Basically, this suggests that “correlations across national markets are lower than correlations across stocks in most domestic markets” (Jorion & Khoury 1996, p. 275). These lower correlations among stock returns across countries was rationalized by Roll (1992), who explained that countries tend to specialize in different industries. The risks associated with each country would therefore depend on its specific industries. Accordingly, stock prices would be impacted differently.

However, the reduction in risk, or volatility of the returns, only forms part of the motivation to diversify internationally. The remaining important factor is the improvement in returns of a portfolio when including foreign financial assets. Levy and Sarnat (1983) point out that a relatively low degree of co-movement between the returns of different assets or markets enables investors to reduce the *variability* of their overall performance by shifting their investment strategy from

a *single* market-asset approach towards *diversification into several* markets or assets. Using mean-variance approach, with two separate set of data 1961-1969 and 1970-1979 with the assumptions on required return, the authors build the optimal investment portfolio for each investor (of different currency bases) in these two different periods. Such time separation is due to the significant fluctuation of currencies after the collapse of the Bretton Woods in early 1970s (officially ended in 1976 under the Jamaica Accords). Accordingly, Levy and Sarnet have proved that the composition of an optimally diversified portfolio depends on (1) the investor's points of view, in other words their *base currency*, and (2) the point of *time* due to the instability of the correlations of returns of different markets and assets.

It is worth noting that most of the studies on the benefits of internationally diversified portfolios use "ex-post" average returns as the proxy for expected returns. In other words, the higher returns in international portfolios in these studies are attributable to the fact that investors already "know" the best choice at the time of investment, hence, the *estimates* for expected returns are already biased. Further, most of the studies have not taken into account other risks when investing abroad, such as capital controls, exchange risk, and political risk (Jorion & Khoury, 1996). Therefore, there have not been much investments in foreign assets during the time 1980s until end of 1990s. Jorion and Khoury (1996) cited the data of foreign investment by pension funds in 7 developed countries (Canada, France, Germany, Japan, Netherlands, UK and US) in 3 years (1980, 1985, and 1990), which showed a very low proportion of foreign assets in the selected pension funds' portfolios, not to mention that the portfolios of US pension funds were almost pure US-assets even though non-US stocks and bonds accounted for 66.7% and 57.5%, respectively of the world's financial assets in 1990 (Jorion & Khoury 1996).

Another possible explanation suggested for such heavily domestically invested portfolios despite the large proportion of foreign financial assets in the world's capital markets is the *home bias* or *home asset preference*. This would also impact on the investors' currency hedge ratio.

In conclusion, the search for the proof of improved risk-adjusted returns of internationally diversified portfolios is still going on. In the meantime, the key question for investors who have foreign assets in their portfolios is how to manage

the currency risk arising from their foreign currency denominated investments. Consequently, investors have to make two main choices in relation to foreign currency risk: (1) strategic choices for foreign asset allocation and (2) policy for managing currency exposure (Litterman et al., 2003).

### ***3.2. Foreign currency risk: to hedge or not to hedge***

Strategic currency hedging policy, or strategic foreign asset allocation decisions, takes long-term considerations of the portfolio's volatility into account. Jorion and Khoury (1996) advocate that portfolio managers managing international investments should make decisions on both the underlying asset and the currency. This is because a manager's expectations for the development of the underlying asset and the corresponding currency might very well be the exact opposite of each other. By solely taking a long position in a foreign asset, the manager is at the same time taking a long position in the currency. Therefore, if the currency is expected to depreciate, the manager should be short the currency instead, i.e. hedging the foreign asset investment.

Accordingly, **modern portfolio theories** consider currency as a *separate asset* in the portfolio, that is, its exposure, or *weight* in the portfolio, can be computed based on the correlation between the *return on currency* and those of other asset classes. Jorion and Khoury (1996) formulate the optimal positions of each asset in a portfolio comprising of stocks, bonds, and foreign bills. Accordingly, using the replication of forward contracts with domestic and foreign bills, they break down the portfolio into two components: (1) stocks and (2) currencies which are the forward contracts (assuming that the payoffs of all domestic and foreign bills in the portfolios can be replicated through a right amount of respective forward contracts). From there, they arrive at the optimal positions of stocks and forward contracts in the matrix notation as follows:

$$\begin{pmatrix} y_s = \Sigma_{s,f}^{-1} \mu_s - \Sigma_{s,f}^{-1} \beta' \mu_f \\ y_f = \Sigma_{ff}^{-1} \mu_f - \beta y_s \end{pmatrix}$$

in which  $y_s$  and  $y_f$  represent the position matrix of stock (s) and forward contracts (f);  $\Sigma_{sf}$  represents the covariance matrix between stocks and forward contracts;  $\Sigma_{ff}$  represents the covariance matrix of forward contract returns only;  $\beta =$

$\Sigma_{s,f}^{-1} \Sigma_{ff}$  as the regression coefficients of the assets on the hedges;  $\mu_f$  and  $\mu_s$  represent the partitioned matrices of returns of forward contracts and stocks only. Accordingly, the optimal currency positions  $y_f$  depend on the optimal stock positions  $y_s$ . Further,  $y_f$  has two components, including (1) the first one as a speculative part that helps the portfolio achieve the highest possible Sharpe ratio with the currency position, and (2) the second one as the minimum-variance hedge for the stock positions ( $y_s$ ). The first part is driven by the *non-zero expected returns of forward contracts*  $\mu_f$ . Since the above derivation is possible based on the assumption of the *log portfolio* – whereby investors have a *logarithmic utility function*, the portfolio could be decomposed into stocks and currencies. Hedge ratio is then defined as *minus* the ratio of the weight of the currency  $i$  bills to that of stock  $i$  in the log portfolio:

$$h^i = -y_f^i / y_s^i$$

Built on the same views, International Asset Pricing Model (IAPM) – an aggregation of consumers across countries – provides equilibrium expected returns for stocks and currencies from which *optimal positions* for stocks and currencies across investors are found. The model was first developed by Solnik (1974) based on different consumption opportunity sets all over the world and assumptions on portfolio choice and investors' homogeneity in wealth and utility functions as well as the expectation on distribution of asset returns.

Black (1990), on the other hand, suggests a *universal hedge ratio* that is optimal for all investors with the assumptions that all investor have the same risk tolerance and each national wealth is exactly equal to the value of each stock market, i.e. the national capitalization. However, Adler and Prasad (1992) argue that the universality of the hedge ratio follows the assumption that investors have homogeneous expectations, which is not realistic.

Another view on currency hedging is *unitary hedging*, or full hedging, which is advocated by Pérold and Schulman (1988). Accordingly, exposure of foreign investments is fully hedged in the forward market because it is believed to reduce the volatility of returns without any reduction in returns. They believe that currency hedging is a “free lunch”. However, empirical studies mentioned later show that there is no such “free lunch”. As Jorion and Khoury (1996) later argue, unitary hedging is based on the assumption that currency returns are expected to



be zero, which, according to them (Jorion and Khoury), is not the case. They argue that in equilibrium, currencies could very well be characterized by non-zero expected returns, in which case unitary hedging is inappropriate.

**Empirical studies** suggest that *full* hedging for both *single-* and *multi-currency* bond portfolios is optimal. Meanwhile, hedging ratios for equity investors are dependent on the investors' base currency as well as time specific. Further, bond investors enjoy more benefits than equity investors when managing their currency exposures.

Litterman et al. (2003) study the benefits of currency hedging policy from the perspectives of investors from four countries USA, UK, Japan and Europe. They found out that ***currency hedging would affect different asset classes differently***. In particular, a bond portfolio is less volatile than an equity portfolio given at any level of currency hedging, and the impact of currency hedging on bond portfolios are more profound than that on equity ones; the volatility of bond portfolios is reduced by half when changing from being completely unhedged to totally being hedged, regardless of the base currency. Therefore, they suggest that the *optimal currency hedging level for foreign fixed-income assets is 100%*. Further, for *mixed portfolios*, i.e. with both equities and bonds, the optimal hedging level recommended is *60-80%* of the total currency exposure, depending on the currency.

However, Litterman et al. (2003), by using the *implied return analysis*, also found out that “the greater the currency hedging, the lower the *implied currency return*”. By using the implied return analysis, Litterman et al. avoided the estimation error of other studies that use ex post data on determining the optimal currency hedging as mentioned in the previous section.

Glen and Jorion (1993) study both stock and bond portfolios with one-month forward contract as the main hedging instrument. The unrestricted mean-variance optimization approach is employed. Accordingly, one of the main findings is that hedging *significantly improves* the performance of portfolios containing *bonds*.

Campbell, Medeiros, and Viceira (2010), by using the sample data spanning from 1975 to 2005, find that international stock portfolio investors can minimize volatility of their portfolios by taking short positions in Australian and

Canadian dollars, Japanese yen and British pound, while being long in USD, EUR and CHF would be beneficial to them. This is due to the positive and negative correlations of the two above currency groups, respectively, with the returns of the respective stocks. Further, full hedging in bond portfolio is also recommended from a risk perspective.

A case study done by Chiu and Lai (2017) on a few Taiwanese pension funds shows that for foreign bond investments, the risk-minimizing strategy is basically 100% hedge whereas that of foreign stock portfolios depends on the respective stock markets and currencies.

Kristjan (2012) also found that optimal hedge ratio for bond portfolio in most cases are close to 100%. However, Swedish bond holders of US Treasuries would historically have reduced the volatility of returns by having 5-10% exposure to USD (instead of zero as in full hedging).

De Roon, Eiling, Gerard, and Hillion (2012) look at the impact of hedging on to portfolio at higher moments of portfolio returns. It is shown that currency hedging does reduce portfolio variance at the expense of the average portfolio returns. Thus, Sharpe ratios in out-of-sample returns do not significantly improve or even decrease, in other words, there is no free lunch that was claimed by Pérold and Schulman (1988). In addition, the results in the study have provided a new highlight that *mean-variance framework is not appropriate for assessing the impact of currency hedging on portfolio performance.*

### 3.3. Active currency management

Active management of currency was first introduced in *overlay hedges* whereby a core portion of the portfolio is managed by a primary manager, while the currency risks are managed separately (Jorion & Khoury, 1996). The strategy arose as a solution to the lack of currency management ability of the primary equity managers. This approach employs the same weights for forward contracts (currency management) that we saw in the global portfolio optimization earlier, but the weights for equity are determined based solely on the covariance among stock returns and expected excess returns of stocks ( $\sum_{SS}^{-1} \mu_S$ ):

$$\begin{pmatrix} w_S = \sum_{SS}^{-1} \mu_S \\ w_f = \sum_{ff}^{-1} \mu_f - \beta w_S \end{pmatrix}$$

Whereas a passive overlay strategy manager is constrained to track a predefined benchmark, such as e.g. always hedge 100% or 50% of the foreign currency exposure, an active overlay strategy manager is free to follow different ideas and strategies. If a manager with an active management mandate believes in an appreciation or a depreciation of a particular currency, he or she will decide to hedge accordingly. After all, the objective of an active overlay manager is to partially reduce currency risk while actively seeking return (Levich & Pojarliev, 2012). However, Jorion and Khoury (1996) argues that one of the problems with overlay strategies is that the underlying assets (equity) completely ignore the impact of currency risk and will therefore be *suboptimal* to the global portfolio optimization introduced earlier.

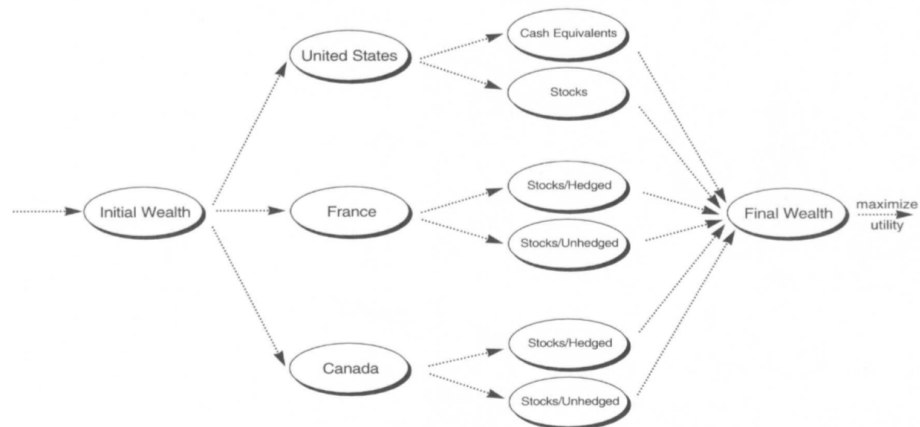
Jorion (1994) studies the *currency overlay strategies* in bond and stock portfolios. He finds out that optimal hedging with *joint optimization* of both underlying assets and currencies gives the highest benefits, with an increase in the returns of 273 and 173 basis points for bond and stock portfolios, respectively, at their respective volatility rate of 10% and 15%. The result also shows that fixed-income portfolio benefits much more than equity ones in currency management. Further, currency overlay strategy where the underlying asset portfolio is predetermined proves to bring less than half of the returns (102 basis points vs. 273). However, this is based on *ex-post data*, that is, when the foreign exchange rates and asset returns are known. In the real-world, ex-post exchange rates are usually predicted using forward premium, which is the interest rate differential by interest rate parity. The hedge uses forward contracts over a passive benchmark, which is suboptimal but easy to implement. Jorion (1994) designs hedging strategy based on the estimated return and risk using variance/covariance matrix of the past four-year moving window data and most recent forward premium. The strategy shows to work for stock portfolio in the 1978-91 period when the *actively hedged returns* are much higher than the unhedged and fully hedged ones. One caveat of this active management strategy is in the case of fixed exchange rate systems where the volatility is *not* well assessed by historical data.

Glen and Jorion (1993), in their study on the currency management in international bond portfolios, conclude that the separation of bond and currency management does not take full advantage of the currency hedging. This means that, overlay managers given a nominal portfolio with the aim to generate as much

return as possible through currency exposures would not have the full picture of the correlation of the components in the overlay and investment portfolio. Therefore, they might miss the opportunity to fully exploit between the assets.

Duarte and Rajagopal (1999) propose another approach to the optimal currency overlay by using scenarios. The method is developed based on the similar approach used for active asset allocation proposed by Koskosidis and Duarte (1997). Accordingly, an international investor with investments denominated in a few currencies could establish his own estimates of the expected return of his investments in the near future (scenarios) and his own loss functions in case of hedge and no hedge. The objective function (e.g. return maximization) of the investment could be illustrated through a network node, starting with the initial wealth point (initial investment), spreading out to different investment nodes, with each attached to a few hedging strategies, and eventually leading to the maximization function at the final wealth point. With a given utility function and mean-variance framework, the investor can determine the hedge ratio for each currency which he is exposed to.

A NETWORK FOR OPTIMAL CURRENCY HEDGE



Source: Duarte and Rajagopal, 1999, p. 52.

The scenario-based approach helps address the biggest shortcoming of the mean-variance framework which is the use of a single point of forecast of the returns, which is essentially one scenario (Duarte & Rajagopal, 1999, p. 52). Hence, the more scenarios are considered, the broader moves in the markets are covered, which might produce better result than average expected behaviour. Moreover, by considering different scenarios, stress-test of currency hedging in extreme cases can also be included in the decision-making process.

Combining the two approaches, the mean-variance framework and scenarios, could produce better results for the overlay currency strategies compared to doing each alone.

#### 4. Discussion and concluding remarks

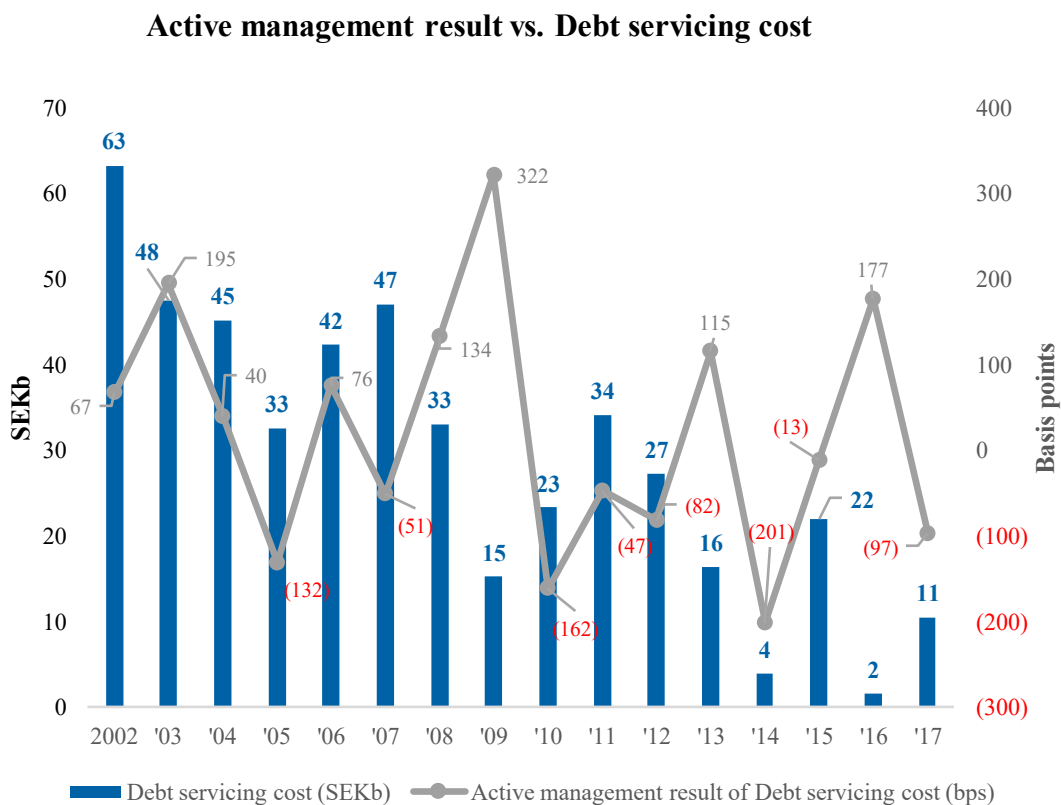
In general, active currency management at SNDO over the 2002-2017 period has generated a return totalling SEK 1,360 million, or equal to an amount of 0.29% of total debt servicing costs in the same period.

**Table 5: Active management vs. Debt servicing cost and the mandate 2002-2017**

Year	Active management result (net) (SEKm)	Debt servicing cost (SEKb)	Active management/ Debt servicing cost (bsp)	Average portfolio managed (SEKm)	Active management/ Portfolio managed (bps)
2002	423.58	63.24	67	386,364	11
2003	928.03	47.55	195	196,434	47
2004	181.85	45.21	40	194,314	9
2005	(428.91)	32.60	(132)	199,344	(22)
2006	320.19	42.32	76	198,305	16
2007	(241.98)	47.10	(51)	194,000	(12)
2008	440.65	33.00	134	200,286	22
2009	489.49	15.20	322	193,819	25
2010	(377.07)	23.30	(162)	197,814	(19)
2011	(161.28)	34.10	(47)	193,000	(8)
2012	(221.97)	27.20	(82)	190,632	(12)
2013	188.58	16.40	115	190,512	10
2014	(78.51)	3.90	(201)	175,000	(4)
2015	(27.53)	22.00	(13)	100,000	(3)
2016	26.52	1.50	177	100,000	3
2017	(102.00)	10.50	(97)	51,000	(20)
<b>Total</b>	<b>1,359.67</b>	<b>465.12</b>	<b>29</b>		

Source: Publicly available annual reports and evaluation reports on SNDO's websites ([riksgalden.se](http://riksgalden.se)), and data provided by SNDO during the course of the thesis

**Chart 4: Active management result vs. Debt servicing cost 2002-2017**



*Source: Publicly available annual reports and evaluation reports on SNDO’s websites (riksgalden.se), and data provided by SNDO during the course of the thesis*

SNDO borrows in foreign currency to, among other reasons, diversify the debt exposure with the aim to reduce the risk-adjusted cost of the Swedish central government debt. Being diversified makes SNDO able to borrow at the lowest possible rate, and also leaves the Debt Office less affected if a debt instrument is temporarily costly. This is aligned with the findings of Solnik (1974), who showed a reduction in risk for international diversified portfolios compared to portfolios consisting of domestic assets only. However, SNDO still needs to consider how to handle the foreign currency risk that arises as a consequence of having debt in foreign currency.

According to Pérold and Schulman (1988), unitary hedging, or full hedging, is appropriate because it reduces the volatility of the returns without affecting the returns. Unitary hedging is therefore considered a “free lunch”. Following their example, SNDO should hedge all of their foreign currency exposure, not striving to obtain one – like they have been doing for many years.

Based on a quantitative analysis conducted by SNDO in the early 2000s, the target foreign currency debt share was set to 15%. This was considered to be the target exposure at which the greatest amount of risk reduction was achieved. However, over the years, new analyses have shown that cost variation have increased by having foreign currency exposure, i.e. the risk have increased (Swedish National Debt Office, 2014, p. 1). In addition, SNDO found no cost benefit of having a certain share of foreign currency debt in the strategic portfolio and has, therefore, decided to have no foreign currency exposure in the strategic portfolio (Swedish National Debt Office, 2014, p. 1). This practice is not only in line with the unitary hedging practice advocated by Pérold and Schulman (1988), but also a practice in accordance with the findings of Litterman et al. (2003), who suggest that a 100% hedging level for foreign fixed income portfolios. Campbell et al. (2010) also suggest full hedging for bond portfolios to be optimal, seen from a risk perspective.

However, even without exposure to foreign currency in the strategic portfolio, SNDO is still exposed to foreign currencies in the actively managed portfolio. As Jorion and Khoury (1996) point out, unitary hedging is only appropriate if currency returns are expected to be zero, which, according to them, is not the case. If there is, in fact, a non-zero expected return, unitary hedging is inappropriate. If SNDO believed there were no currency premium to be earned, no active management of foreign currency would be engaged as it would be impossible to make any profit from active management. Therefore, to engage in active management, there must be an expectation of non-zero return from currencies, which was shown by Jorion (1994) through currency overlay strategy.

The Swedish central government debt portfolio is constructed by first identifying the type of debt (nominal SEK, inflation-linked or foreign currency debt) based on the macro-economic views (e.g. balance of payments etc.) and the costs. It then considers the optimal currency portfolio with mean-variance approach adjusted with possible constraints and fundamental analyses. Finally, currency overlays are utilized to produce positive excess returns from currency and interest rate positions to offset the borrowing costs from the underlying portfolio. Between the second and third steps, strategic views on the SEK rate, given sufficient confidence, might lead to substantially large position in one or more currencies. Such decisions, known as *strategic position taking*, have generated both gains (USD position in 2008 and SEK position in 2009) and losses



(CHF position in 2014) depending on how the speculations materialized. The decisions also significantly alter the currency composition benchmark and takes into account longer-term views. However, this is not the alpha generation as in active management but more of a result from the currency benchmark decision.

Currency overlays, as Jorion (1994) pointed out, are suboptimal compared to the joint optimization approach, especially for *extremely risk-averse investors* who will choose to take *no* position in currencies at all. In other words, this depends on the risk appetite of the portfolio managers and the investors – in case of SNDO, it is the Director General and the Board. Even though portfolio managers, both internal and external, are given their own mandates and risk limits and the *full* authority to decide on positions taken, there is still possible intervention from the Board and/or Director General in the extreme cases. This happened once in 2014 when there were substantial losses in mid-2014 and the Director General ordered one of the internal managers at the time to liquidate all the outstanding positions at the time to avoid further losses. However, had SNDO continued those positions until early 2015, they could have created enough gains to both cover the losses and generate profits from the positions. This shows that currency overlays depend significantly the risk appetite of the portfolio managers and the management.

Active currency management at SNDO, though considering the risk limits of the positions taken, is mostly to generate returns to the overall debt portfolio to reduce the costs. The fact that managers are assigned with separate fictitious portfolios and aim to generate as much returns as possible within the allowed risk limits may have had negative impact on the volatility of the debt portfolio due to the correlation of exchange rates and the bond returns. However, due to lack of data, this is not quantified.

### ***Going forward***

The VaR mandate has changed over the years, with a general larger mandate in earlier years. The main goal in these years was to reduce the cost of the central government debt. Today, active management serves as a more integrated part of SNDO's debt operations rather than a separate business line with support from different internal resources such as risk management and other debt analyses. Active management helps SNDO provide information that can be used in other parts of the organisation such as in funding decisions and any

strategic long-term position taking. By being involved in the market through active currency management, the internal managers can maintain up-to-date and intact knowledge about the markets. At the same time, the managers can keep their eyes open for possible strategic positions to present to the board. In addition, when less risk is taken on in the active management, the managers are better suited to present such strategic decisions to the Board.

Time and resources allocated for active management of foreign currency debt have decreased over the years, as a natural response to the decreasing foreign currency debt in the central government debt portfolio. During the external management program, at least four full-time managers were engaged in the internal management operations, with support from people working within risk and jurisdiction etc. Minimum three and maximum six external managers were engaged at all times during the period. Today (2019), the internal operation of active currency management is done by a team of three, with one in charge of fixed income, one for forex, and one acting as the portfolio manager responsible for the whole portfolio risk exposure and macro view. Due to the reduction in investment mandate now compared to those in early 2000s (see table 5 above), all three managers now devote only 20% of their time on active management operations, compared to the full-time role in the earlier years. In 2018, the external management program was ended, and no external managers are engaged at this point onwards. SNDO have created more strategies for position-taking in-house to stay diversified within the active management.

Whether external managers will be hired again in the future is an unanswered question. The small share of foreign currency debt in the total central government debt portfolio makes it unreasonable to allocate the necessary time and resources for maintenance of an external management program (now 5% compared to 15% - 35% in the period from 1992 up until 2010s). However, in the event of a sudden increase in the foreign currency debt share, there are reasons to believe that SNDO would resume the program. As we have seen, during the period from 2002-2017, SNDO have, with the help of external managers, generated a return of SEK 1,360 million, and even billions since the practice was initiated in 1992.

On the other hand, in the case of a resumption, the fee structure should probably be reviewed. In one of the reviews done by the Finance Committee, ESV is proposing a ceiling fee structure with the conviction that total fees paid over the

10-year period from 2007-2017 could have been reduced by 60% if such ceiling fee had been imposed (Appelgren, 2014, p. 8). Moreover, as seen from table 3 earlier, results of external managers are significantly altered by management fees. In some years, a positive gross result ended up as a negative net result, and the management fees usually reduced the net profit to its half. Still, the external managers help SNDO stay diversified in the active management due to the managers' different strategies, management styles and approaches. Further, the external managers contribute with valuable information and knowledge that can further reduce the cost of central government debt.

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## Appendices

### Appendix 1 – Methodology and research design

This section is to establish the methodology used to obtain answers to our research questions. Firstly, we will explain why we believe case study is the appropriate method. Secondly, we will present the *research design*, followed by the selection of case. Thereafter, we will present the models used, the data collection method, and how we have organized and analyzed the data. The limitations of the method will then conclude the section.

#### *Case study methodology*

The research is an empirical investigation of the active currency management practice undertaken by SNDO over the course of 16 years from 2002 to 2017. The case study is adopted because of our interests on how active currency management is employed in practice. Given the extensive studies on portfolio management and currency hedging since Markowitz first proposed his mean-variance approach in constructing portfolios and the expansion of portfolio theories taking into account international dimensions, the case study on SNDO's active management practice would give us a closer look at how portfolio managers have applied the existing theories and find out if active management could bring more benefits to the country. If the latter is true, countries that have access to a wider base of investors worldwide are advised to diversify their central debt portfolio to other currencies and employ the techniques to help them lower the costs, yet still take into account the risks arising from foreign currency fluctuations.

Our research answers the question “how” when we obtain an understanding of their approach in each year from 2002 to 2017, and “how good/bad” the practice has been when we analyse the results. Therefore, our study is an *exploratory research*, as Robson (2002) says, which is to find out “what is happening; to seek new insights; to ask questions and to assess phenomena in a new light”. As per Saunders, Lewis, and Thornhill (2009), for exploratory research, there are three principal ways to conduct the work: “a search of the literature, interviewing “experts” in the subject, and conducting focus group

interview”. Our study in this thesis explores the literature and interviewing the focus group, in this case SNDO.

The case study design employed in this thesis is the *single-case design*, which is appropriate when having a critical, unusual, common, revelatory or longitudinal case (Yin, 2014, p. 51). Our study has three characteristics of the single-case design as follows:

- Our case is *critical* where we investigate whether SNDO’s strategic and tactical decisions are aligned with the prevailing theories. The study also provides a quantitative appraisal to assess if the performance is effective and, if there is any room for improvement.
- Our study is of *revelatory* character, that is, our study on SNDO’s practice, to our best knowledge, is the first one with such in-depth research on the foreign currency risk management practice. Thus, through the study, we have the new-gained opportunity to observe and analyze.
- Our study is *longitudinal*, or put differently, it covers a period of time, in which one significant financial event happened (the 2008 finance crisis).

Another dimension of our study design is that it is *embedded* when only the active currency management practice is under study. This derives from our interests in the application of active management of portfolio management.

### ***Research design***

The study is an examination of the *secondary* data about the management of central debts by SNDO from 2002 to 2017. The data is publicly accessible on SNDO’s website, riksgalden.se. At the same time, we have conducted interviews with SNDO on the performance measurements and active management strategies undertaken throughout the research period. The interviews have mainly consisted of email correspondences and phone calls, but also a face-to-face interview with one of the internal managers at SNDO’s office in Stockholm.

With the purpose of understanding *how and why* the foreign currency risk management practice has been done the way it has been done, as well as assessing how effective the approach has been, this study performs both the qualitative and quantitative research. The steps taken include:

- *Qualitative research*: in-depth interviews with SNDO analysed qualitatively to obtain an overall understanding of their typical approach in active management undertaken during 2002-2017.
- *Quantitative research*: we start with the mean-variance portfolio theory developed by Markowitz (1952), and recently developed studies on international portfolio management to form a *theoretical framework* of active management. We construct an overview of SNDO's mandates on active management for both internal and external managers, and their ways to *assess performance* of both types of managers. Then, we perform the valuation of the approach by summarizing the result for each year for the period 2002-2017 based on publicly available data reported by SNDO. From there, we are able to confirm whether the practice has helped the Swedish government save costs on their external borrowings.

## Appendix 2 – Data

- *Primary data* include the interviews about the practice and motivations for foreign exchange rate risk management at SNDO.
- *Secondary data* include (1) the data of foreign exchange rates of certain currencies used by SNDO in their tactical trading, (2) SNDO's proposed guidelines for central government debt management (3) the Government guidelines for central government debt management, and (4) the annual reports and evaluation of central government debt management prepared by SNDO.

## Appendix 3 – Risk management framework

- **Identification**: risk identification is made based on what *has* happened and what *can* happen.
- **Assessment**: based on *probability* and *consequences*. Quantitative and qualitative methods are used in the risk assessment process.
- **Measures and priorities**: list of decision alternatives in response to the identified risk, including eliminate, limit, transfer (i.e. insure), and retain the risk without action.
- **Implementation** of the measures decided: efficient and effective internal operation requires risk awareness within the organization.

- **Reporting and follow-up:** continuous and active monitoring and evaluating the *effects of the measures taken*. Losses incurred from the measures taken, any disturbances and/ or damages are considered in the planning development and improvement work.

#### **Appendix 4 – VaR calculation**

(Source: 2018 Financial and Risk Policy)

Step 1: calculate variation of each factor daily

Step 2: obtain *exponential* weighted average for each factor – whereby weights are attached to events close to earlier events. SNDO adopts a weight factor 98% (decay)

Step 3: calculate covariance between factors

Step 4: construct a portfolio cash flows based on the *maturity* factors (18 intervals)

Step 5: calculate VaR with confidence level of 95%

The back-testing of VaR is reviewed annually.

#### **Appendix 5 – Decision mandate in management of Central Government Debt**

##### **a. Decisions taken by the government**

- *Structure of central debt:* the detailed percentages of the three types of debt: foreign currency debt, inflation-linked debt and nominal SEK debt.
- *Amortization of foreign currency debt:* maximum amortization of foreign currency debt, which is the net of total borrowings in foreign currency, and repayments in the year.
- *Maturity:* the maturity of the whole debt portfolio, as well as of each debt type.
- *Limitation in position-taking:* active position taking aimed to lower the costs while taking the risk into account, and risk measures for position takings are of great importance to ensure the goals are met. The measure taken is daily Value-at-Risk (or VaR), which specifies the maximum position taken in *derivative instruments* except for those that relate to SEK exchange rate with other currencies.

- *Market and debt support*: SNDO is responsible for maintaining the proper functioning of the markets for government securities in addition to the goal of long-term cost minimization with due consideration for the risks.
- *Retail market borrowing*: SNDO to borrow in retail market for the lower costs.

#### **b. Decisions taken by SNDO**

Decisions delegated to SNDO include those taken by (1) the Board of SNDO – strategic decisions, and (2) SNDO management team – operational decisions.

- *Strategic decisions*:
  - Distribution of debt by type
  - Currency benchmark for SEK and foreign currency debt, as well as target currency composition of foreign currency debt
  - *Strategic positions*<sup>5</sup> in foreign currencies
  - Guiding principles for market maintenance and debt management
- *Operational decisions*:
  - The implementation of borrowing the debts
  - *Position taking*<sup>6</sup> in (1) foreign currency and (2) interest rate
  - Operational management for FC exchanges – this arises after the government’s decision to allow SNDO to perform foreign exchange trades with market players other than Riksbank
  - Targets on market maintenance and debt management

### **Appendix 6 – Government guidelines on evaluation of SNDO’s decisions**

*Evaluation of SNDO’s decisions* are done separately for strategic decisions and operational decisions.

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<sup>5</sup> *Strategic position* taking refers to the positions in the SEK exchange rate made by the Board under the assessment of the future value of the currency and its interest rate. The position is large, from SEK 7 billion to SEK 50 billion, and kept for a long-term period, usually more than one year. The position is taken in developed markets and is to be built up gradually and announced in advance.

<sup>6</sup> *Position taking* decisions made by SNDO’s management team (i.e. the internal managers) are taken through derivative instruments for a much shorter period of time, usually less than one year. The positions can be taken in both foreign currencies and interest rates and both by internal and external managers. This is also known as *active management* of foreign currency.

- *Strategic decisions*: three main approaches for evaluation the performance of SNDO's decisions include (1) *deviations* from the benchmark decided earlier at the beginning of the year, (2) qualitative assessment factoring cost and risk, and (3) counterfactual approach – whereby the results of counterfactual decisions are compared against the actual ones.

Accordingly, the following strategic decisions are assessed and evaluated:

- (1) amortization rate of the FC debt – *qualitative and quantitative analyses, which reasons behind the decision and counterfactual comparison*
  - (2) deviation intervals for the inflation-linked debt – *qualitative*
  - (3) maturity benchmark choices of different types of debts – *qualitative*
  - (4) decisions on currency benchmark – *qualitative*
  - (5) principles for market and debt support – *qualitative*
  - (6) delegation of risk mandate for position taking – *qualitative*
  - (7) strategic interest rate and foreign currency positions – *measured in market value*
- *Operational management*: the following aspects are considered:
    - Borrowing in and managing the different types of debt – qualitative and on ex-ante basis (i.e. forward looking) and quantitative (cost comparison between borrowing in inflation-linked bonds and nominal SEK bonds for the last five years)
    - Market and debt support – qualitatively
    - Retail market borrowing – quantitatively through cost savings from borrowing in retail market
    - Operational management of FC exchanges – deviations from the fluctuation intervals around the cost-neutral path for the exchanges of SEK and FC.
    - ***Operational interest-rate and FC positions***

## Appendix 7 – Changes in risk mandates 2006-2017

*Source: Government guidelines, 2006-2017*

**2006:** First issue of Financial and Risk Policy was published.

**2007:** New control system for position-taking, where the risk mandate is set at SEK600M measured as daily VaR, and applies to all positions, both strategic (Board positions) and operational (active management)

**2009:** Mandate for long-term positions in SEK exchange rate was increased from SEK15B to SEK50B on May 28<sup>th</sup> for SNDO to exploit the potential for lower borrowing costs made possible by the level of the SEK exchange rate at that time

**2010:** Long-term positions in SEK exchange rate *need not* be taken in derivatives only, because it can be effective to borrow directly in foreign currency to create exposure. These long-term, strategic positions are now *exempt from the limit in terms of VaR* and shall only be taken when the SEK exchange rate clearly deviates from its long-term value.

**2011:** Reduced VaR mandate to balance out the higher risk resulting from the increase in mandate for long-term positions in SEK exchange rate that came into effect 28<sup>th</sup> of May 2009

**2012:** Reduced mandate for long-term positions in SEK exchange rate because Swedish krona currently at a level regarded as more long term and because of predominant downside risk in Swedish economy

**2013:** Reduced mandate for long-term positions in SEK exchange rate limits risk of losses in position taking operations

**2014:** Reduced VaR mandate implies less potential for cost savings but also reduced risk of losses. Benefits in terms of market focus and expertise in financial matters remain

**2015-2017:** no changes

**Appendix 8: Fee structure for external managers 2001 – 2017**

Period	Fixed fee	Variable fee	
		Percentage return of portfolio value	Fee (% of the return range)
29/12/2000 –	3 bps	0.25% - 0.5%	10%
01/10/2003		> 0.5%	20%
01/03/2004 –	3 bps	0.25% - 0.5%	10%
01/10/2006		> 0.5%	25%
01/01/2012 onwards	3 bps	> 0.2%	20%

**Appendix 9 - Highlights of performance of active management 2002-2017**

*Source: Annual reports and evaluation reports 2002-2017, retrieved from <https://www.riksgalden.se/en/press/publications/Annual-report/> and <https://www.riksgalden.se/en/press/publications/Evaluation-of-central-government-debt-management/>*

**2002:** During the year, currency positions accounted for the profit. The internal management took positions for a stronger EUR in relation to USD, CHF and JPY, with the former being the main contributor to the positive result. Position for a strengthening of the NOK contributed in the same direction. On the interest rate side, the internal management took positions for lower interest rates in Europe, and for the US interest rate to exceed the European. The former was successful, while the latter drove the result for the overall interest rate positions to a slight negative. External managers, too, made a profit from currency positions, while the result of interest positions varied between the managers. Their positive result in currency positions were mainly attributable to positions for a stronger EUR in relation to USD, and the managers that performed well on the interest side had chiefly taken positions for falling interest rates throughout the year.

**2003:** In 2003 annual report, SNDO stated that since the first adoption of active management, the internal and external managers have produced a cost saving of SEK12B, or 0.36% of foreign currency debt, mostly coming from *fixed-income positions*. Most of this year's positive result came from currency positions in which SNDO positioned itself for a weaker USD. EUR was bought for USD in



the first half of the year, and JPY was bought for USD in the second half. The Debt Office was also positioned for a stronger EUR in relation to CHF. On the interest rate side, SNDO was positioned for a lower European interest rate, as well as for the US interest rate being higher than the European, which was a successful strategy.

**2004:** Currency positions accounted for the positive overall result of the year. Interest rate positions produced a negative return.

**2005:** The Debt Office took position for higher interest rates in Japan and the US, which produced positive results. The currency positions on the other hand, in which EUR and JPY was financed with sales of USD, resulted in the highly negative result for the year.

**2006:** Internal management's profit this year came from interest rate positions. Differences in short- and long-term interest rates decreased in Sweden and other countries during the year. The SEK strengthened against other currencies measured as TCW<sup>7</sup>, a weighted average of the SEK value in relation to other currencies.

**2007:** Concerns about the US housing market and the sub-prime loans in particular caused upward and downward moves in interest rates over the year. The USD weakened against most currencies. Sweden's economy did well in the autumn; employment rates rose, and long-term interest rates did the same. Short-term interest rates fell, though, as a consequence of the international credit crisis. This year's loss is explained by interest rate positions. Currency positions made a small profit.

**2008:** Movements in foreign exchange and fixed income markets were extreme this year as a result of the ongoing financial crisis. Profit came mainly from currency positions in the internal management, but interest rate positions contributed to the positive result as well. During the year, external managers performed better than they ever have.

**2009:** During the year, most of the profit or the internal management came from currency positions, but interest rate positions contributed to the positive result as well. For the external managers, the results varied a lot between them.

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<sup>7</sup> TCW: "total competitiveness weights", the exchange rate index was first published by Riksbank (the Swedish Central Bank) on November 18<sup>th</sup>, 1992. The index acts as a yardstick for the value of Swedish krona: a high value of the index means the krona has depreciated and vice versa. (Riksbank, n.d.)

**2010:** This year, SNDO took interest rate positions for higher two-year interest rates in the US and Germany. During the first five weeks of the year, the Debt Office experienced losses when the interest rates in fact decreased, particularly so in Germany because of the turbulence in Greece. The other interest rate positions taken during the year turned out to be no better and resulted in large losses. Currency positions were taken for an appreciation of the NOK and a depreciation of the JPY. The latter turned out to produce negative results, as the JPY actually appreciated. Position for a stronger USD in relation to EUR also resulted in losses when the USD instead weakened. A small position for a stronger CHF in relation to EUR produced positive result. The external managers as a whole delivered strong results, with Mellon being the most successful manager hired during the year.

**2011:** The year was characterized by uncertainty in financial markets, and the European market showed signs of stress. On the interest rate side, the internal management took positions for flatter yield curves in Europe and the US, which proved successful given that long interest rates fell to record low levels. Positions for rising interest rates in the first half of the year turned out to be less successful, and most of the losses took place at this point in time. Currency positions for a stronger USD in relation to EUR produced positive results, while positions for a weaker CHF and JPY turned out to contribute adversely to the result.

**2012:** Market was characterized by interest rates falling to record low levels, and of political developments rather than macroeconomic developments. In the first quarter, the improving US labour market, as well as liquidity injections by ECB in Europe, drove the interest rates upward. This upward trend of the interest rates was however turned around in the second quarter; when the labour improvement stopped and concerns about development in Greece escalated, interest rates showed a steep decline. The internal management's position-taking was largely affected by these market conditions, and experienced losses when interest rates fell. These losses were to some extent alleviated by positions for flatter yield curve in Europe as well as positions for interest rates rising from negative absolute levels. The internal management positioned itself for a stronger USD in relation to AUD, EUR and JPY. Timing difficulties in relation to the EUR positions contributed to a negative result, whereas the weakening of the JPY contributed to positive result.

**2013:** World economy, and the US economy in particular, was improving. Macroeconomic developments started to diverge again after the financial crisis of 2008/2009 – the US unemployment rate fell to 7%, whereas the European rose to over 12%. Japanese and European central banks started quantitative easing, while US central bank announced its intentions of reduction in that regard. The internal management took positions accordingly, not only for the divergence in growth between US and Europe, but also for other parts of the world. This contributed to a high result for the interest rate positions, however, despite the macroeconomic view, EUR strengthened against the USD by 5% and reduced the gains. Interest positions contributed to the positive result as well – the internal management took positions to lock in the very low interest rates. External managers' losses can to a large degree be explained by their positions for decreasing interest rates, whereas they in fact rose sharply during the summer.

**2014:** In August, SNDO put a ceiling for aggregate losses in the current administration. At the same time, they decided to carry out an in-dept evaluation of the positions and the position-taking mandate. All internal positions were closed down to conduct the evaluation. A new structure that limits losses for a rolling 12-month period was adopted in the following autumn. The limit was set to SEK 250 million, and the new system started operating in January 2015. During the year, the internal management took positions for a higher US interest rate, motivated by a higher growth rate in the US than in Europe. This should have resulted in a tighter monetary policy in the US with higher interest rates and a stronger USD in relation to EUR. However, the US ten-year interest rate fell from 3% to 2.15%, resulting in a loss in interest rate positions. The positions for a stronger USD, on the other hand, made positive results, but the strong reinforcement of USD happened after SNDO's internal management had closed down its positions. The external managers also took positions for a stronger USD, which contributed to the high returns, and interest rate positions for a higher interest brought the return in the other direction. During the year, there were high spread in returns between the external managers hired.

**2015:** Internal management took positions mostly based on the differences in growth rate and inflation in the US and Europe. In three out of four quarters the positions developed well, but in the second quarter, German interest rate rose sharply, and USD weakened. The new loss block system, implemented in January, limited the consequences of the positions; however, it also prevented the loss from

being recovered when the market turned around short time thereafter. External managers mainly took positions for a stronger USD and divergence in monetary policy. Results differed a lot between the managers but generated a positive result in total.

**2016:** There were no internal position-taking in 2016, except for a few remaining positions entered into in 2015 that matured in the start of the year. During the year, SNDO was commissioned by the Government to carry out an analysis on “whether position activities could be expected to contribute to reducing costs and risks for the central government debt as a whole” (Basis for Evaluation – Report 2016). SNDO concluded that the possibilities to reduce costs of central government debt by taking positions were good also in the future. This was mainly due to SNDO’s ability to act in a “long-term and sustainable manner”, compared to other market participants. The position-taking framework was amended, and the stop-loss rule of 2015 was removed. For the external managers, currency positions contributed to positive result, whilst interest positions generated a negative one. Gains in currency positions stemmed largely from the fall in UK long interest rates and the weakening of the GBP that happened due to financial uncertainty in connection to the referendum regarding Brexit. Strengthening of the JPY also contributed to the positive return. The negative result in interest rate positions was mainly due to the rising interest rate in connection with the US Presidential election, which went against the manager’s expectations of a lower spread between European and US interest rates.

**2017:** Market was characterized by global optimism with regards to growth, low interest rates and record high levels on the exchanges. Short rate became higher in many countries; hence, yield curve became flatter. Interest rate and currency markets had low volatility. Internal position-taking was resumed in January 2017. Internal managers took positions for a stronger CAD, a stronger AUD and EUR in relation to USD, and a weaker CHF, which all contributed to the profit. Most of the return came from the former, and three quarters of overall internal management’s results came from currency positions. Positions for a steeper yield curve in Germany and a flatter yield curve in United States also contributed to positive result on the interest side. External managers’ loss came mostly from currency positions, in which positions were taken for a stronger USD in relation to CAD and GBP. Positions in the German and UK interest rate generated losses as well. All of the external managers reported negative results,

which is unusual. The current mandate was set up under different market conditions, and the limits set on interest positions made it hard for the managers to attain an optimal portfolio mix of interest rate and currency positions, thereby leading to an overweight in currency positions. SNDO started to review the mandate this year.