

# A test of momentum strategies in funded pension systems - the case of Sweden

Tomas Sorensson\*

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\*Department of Industrial Economics and Management  
School of Industrial Engineering and Management  
KTH-Royal Institute of Technology  
SE-100 44 Stockholm, Sweden

E-mail: [tomas.sorensson@indek.kth.se](mailto:tomas.sorensson@indek.kth.se)

## **Abstract**

This study investigates mechanical computer aided momentum strategies for saving in the Swedish Premium Pension System (SPP). The results are valid for saving in other systems as well.

Since the public pension system in Sweden changed in 2000, it has been widely debated. In the last two years the debate has intensified, especially concerning the individual part of the system. While it is largely recognized that most European countries need to change their pension systems, Sweden was the first country in Europe to actually make changes to their pension system. How well the new Swedish system is working is of great interest not only for the Swedish population, but also for many other Europeans. For countries considering changing their pension system, the Swedish experience provides interesting alternative for their choice of solutions. One feature of the Swedish system that makes it interesting is that it has an individual part, so how this individual part has been handled by the Swedish population is especially worth a closer examination.

The new pension system has triggered a substantial amount of research. The latest research on how the individual part has been working in the new system is a study by Dahlquist and Martinez (2012) and a study by Dahlquist, Martinez and Söderlind (2011). They find that active investors outperform passive investors. The better performance by active investors can be attributed to dynamic fund selection according to their analysis.

Unfortunately, this research does not give any firm advice to investors on how to handle the mutual fund selection and how often the investor should change funds. Our research takes the perspective of the investors that need to decide on how to invest in the Swedish Premium Pension System (PPS) with more than 800 funds and with a long-time horizon. The research question is: What wealth would investors have accumulated over the entire period by using a computer aided momentum strategy? Answering this question could offer some sound advice for investors both inside the system and outside the system.

A number of researchers argue that the momentum effect described by Jegadeesh and Titman (1993) explains the superior performance of top funds, for example Grinblatt, Titman and Wermers (1995) and Carhart (1997). Using monthly returns in their studies, they find that the performance of funds that used momentum strategies on average realized significantly better performance than other funds. Momentum for stocks and other asset classes have been also been documented by (Fama and French (1992), Jegadeesh and Titman (1993), Grinblatt and Moskowitz (2004), and Asness, Moskowitz, and Pedersen (2009).

Using daily mutual fund returns, Bollen and Busse (2004) study the issue of persistence in mutual fund performance by focusing on a relatively short measurement period of three months. Their results provide evidence regarding short-time persistence since they find that the top decile of mutual fund managers generates a statistically significant quarterly abnormal return that persists for the following quarter. When using weekly or monthly returns, the

top decile of funds does not exhibit superior performance. In this empirical study we try to answer over what time horizon this ability persists by using daily data and different time horizons.

The Swedish Pension System is a mandatory system and it covers all citizens and by the end of 2010 it included over 6 million individuals and more than 400 billion SEK were under management in the PPS. It is administrated by the Swedish Pensions Agency, but how to invest in the mutual funds needs to be decided by the individual participant. Each year 2.5 percent of the yearly pay is assigned to this individual part of the pension system in Sweden. The amount is maximized, in year 2012 it was around 9700 SEK.

All 1362 mutual funds that have been in the system during the period 2000-2011 are investigated. These funds represent a majority of the mutual funds that Swedish retail investors can invest in. The funds cover markets around the globe and many different types of assets. We use daily data for all funds and the tests are performed using the actual administrative handling of funds that is used by the Swedish Pension Agency.

In the study we test different measuring and holding periods, 30 days, 60 days, 90 days, 180 days and 365 days. We test strategies with portfolios of five funds because that is the maximum amount allowed in PPS. We perform tests by selecting the five funds with the best return and worst return over the time period used. No short selling is allowed in this system.

We show that over this period a strategy that builds on momentum increases the original invested amount over the period 2001-2011 by four times. When we include a Stop-Loss function the wealth increase is over six times the original invested amount. The best strategy for portfolio selection is to invest in the five funds that have had the best return over the last 30 days. After 30 days the portfolio is rebalanced and the five funds that have had the best return over the last 30 days will be the new portfolio. For longer time horizon the return are lower, but for all strategies that build on momentum the returns are positive. Contrarian strategies give mixed results but seem to work with a longer holding period.

## **1 Introduction**

Since the public pension system in Sweden changed in 2000, it has been widely debated. In the last two years the debate has intensified, especially concerning the individual part of the system. While it is largely recognized that most European countries need to change their pension systems, Sweden was the first country in Europe to actually make changes to their pension system. How well the new Swedish system is working is of great interest not only for the Swedish population, but also for many other Europeans. For countries considering changing their pension system, the Swedish experience provides interesting alternative for their choice of solutions. One feature of the Swedish system that makes it interesting is that it has an individual part, so how this individual part has been handled by the Swedish population is especially worth a closer examination.

The new pension system has triggered a substantial amount of research. The latest research on how the individual part has been working in the new system is a study by Dahlquist and Martinez (2012) and one study by Dahlquist, Martinez and Söderlind (2011). They find that active investors outperform passive investors. The better performance by active investors can be attributed to dynamic fund selection according to their analysis.

Unfortunately, this research does not give any firm advice to investors on how to handle the mutual fund selection and how often the investor should change funds. Our research takes the perspective of the investors that need to decide on

how to invest in the Swedish Premium Pension System (PPS) with more than 800 funds and with a long-time horizon. The research question is: What wealth would investors have accumulated over the entire period by using a computer aided momentum strategy? Answering this question could offer some sound advice for investors.

In the PPS investors have to choose among 800 mutual funds, and try to find funds with a positive expected return. Regarding mutual fund performance we should expect a number of fund managers to possess an informational advantage, but the question remains: over what time horizon? Berk and Green (2004) show theoretically that a mutual fund manager's informational advantage will be short-lived as investors put their money in recent winners among funds. A number of researchers argue that the momentum effect described by Jegadeesh and Titman (1993) explains the superior performance of top funds, for example Grinblatt, Titman and Wermers (1995) and Carhart (1997). Using monthly returns in their studies, they find that the performance of funds that used momentum strategies on average realized significantly better performance than other funds. Momentum for stocks and other asset classes have been also been documented by (Fama and French (1992), Jegadeesh and Titman (1993), Grinblatt and Moskowitz (2004), and Asness, Moskowitz, and Pedersen (2009).

Using daily mutual fund returns, Bollen and Busse (2004) study the issue of persistence in mutual fund performance by focusing on a relatively short measurement period of three months. Their results provide evidence regarding

short-time persistence since they find that the top decile of mutual fund managers generates a statistically significant quarterly abnormal return that persists for the following quarter. When using weekly or monthly returns, the top decile of funds does not exhibit superior performance. In this empirical study we try to answer over what time horizon this ability persists by using daily data and different time horizons.

We have collected and computed complete data for all mutual funds that have been in the PPS over the entire time period. Several tests are done, changing the length of the holding period from one month up to one year. The tests also include different compositions of the portfolio of mutual funds. We apply the test on historical data and believe that results obtained are applicable on the choice of a future strategy for investing in mutual funds.

Our findings are that a 30 calendar days<sup>1</sup> measuring period of historical return and a 30 calendar days holding period with change of funds gives a very good wealth increase of four times over the investigated period of 10 years. The rest of the paper is organized as follows: Section 2 describes the Swedish Pension System, focusing on the Premium Pension. In Section 3 we describe the data. The methods used are documented in Section 4. Section 5 contains the results and Section 6 provides the conclusions along with making suggestions for possible future research.

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<sup>1</sup> We use calendar days because ordinary investors think in terms of calendar days and not in trading days.



## **2 The Swedish Premium Pension System**

Within the Swedish public pension system there are two components: a pay-as-you-go financed notional defined contribution plan and the Premium Pension System (PPS) which is a fully funded individual account system. The contribution rate is 16 percent to the first component and 2.5 percent to the individual accounts of the PPS. To secure a minimum pension there is a means-tested benefit.

It is a mandatory system and it covers all citizens and by the end of 2010 it included over 6 million individuals and more than 400 billion SEK were under management in the PPS. It is administrated by the Swedish Pensions Agency, but how to invest in the funds needs to be decided by the individual participant. Although the 2.5 percent seems to be a low amount, the amount could end up to be a very important part of the individual's pension. The growth in value over 30-40 years could be substantial, which makes the individuals choice of investment important.

In the PPS individual participants are offered investments options in the form of a subsample of mutual funds that are offered to retail investors. In 2011 the subsample contained around 800 funds offered to investors. Funds offered are mostly equity funds. Half of the equity funds invest in the Swedish equity market and half in the international equity markets. Investors may choose up to five funds and they can change funds on a daily basis without paying any fees.

For investors that do not want to make any choice, the government established a default fund. Currently there are 2.7 million individuals invested fully in the default fund. Over the years it has been difficult to get individuals to engage in the PPS. The default fund has from the start of the year 2000 invested in bonds and stocks with the objective to achieve high long-term returns with low overall risk. In May 2010, the fund changed to a life-cycle fund.

For participants in the PPS, personal information about their pension is presented every year in a letter from the agency, normally in February. On the agency's website a large amount of information about the funds and the whole system is presented.

### **3 Data**

The mutual fund data has been collected from The Swedish Pensions Agency on all mutual funds that have been offered to investors in the Premium Pension System (PPS). The period we cover is from September 21, 2000, when the PPS started, and up until September 28, 2011. There is no survivor bias in the data, since they include all funds that have been in the system over this period. If a fund has been delisted during the holding period, the amount in that fund has been divided up on the other funds in the portfolio. New funds have been included in the sample when they have been available for investors. The data have been provided by the Swedish Pensions Agency and have been checked and corrected for errors by using other sources on mutual funds such as

Morningstar. The data covers all 1362 mutual funds that have been offered in the system during the period 2000-2011. Table 1 reports summary characteristics for the mutual funds that have been offered in PPS.

In our data we use full fees and not the lower rebated fees within the PPS. There are two reasons for this. The first reason is that with our method it would be very difficult to program and test with the actual fees in PPS. The second reason is that with full fees our tests are valid for investors outside PPS. According to Dahlquist, Martinez and Söderlind (2011) the asset-weighted average fund fee within PPS after the rebate was 0.37 % of assets for active investors in year 2010. The Swedish Pensions Agency also charged an administrative fee of 0.16 % to all investors in the system for year 2010. By using the fee retail investors pay, our results will be more general and applicable for investors outside of the PPS. Today there are tax-exempt savings accounts in Sweden that allow investors to change funds without paying capital gains tax when changing funds and with very low transaction costs.

Daily return series for all funds have been formed for the whole period. The net asset values (NAV) and dividends are used to form daily return series for each fund as follows:

$$R_{p,t} = \frac{NAV_{p,t} + D_{p,t}}{NAV_{p,t-1}} - 1 \quad (1)$$

Where  $NAV_{p,t}$  is the net asset value of fund  $p$  on day  $t$ , and  $D_{p,t}$  are the ex-div dividends of fund  $p$  on day  $t$ .

In this study we use the same algorithm as PPS uses in handling the funds for the investors. Day one the investor submits a request for changing funds. Day two nothing happens with the request from the investor since PPS uses the day for handling the request. Day three<sup>2</sup> all funds that have this day as first day of trade and a NAV value for this day are sold. The cash is then divided up into the requested proportions. After that the requested funds with a NAV for this day are bought for the available cash. Funds that have day four are sold and the new funds are bought for the remaining cash. This procedure is repeated until all funds are sold. For some funds there could take several days before funds could be sold and new funds could be bought. By this approach our calculations build on the same real data as PPS used in their transactions with funds.

#### **4 Method**

This research is focused on ordinary investors' strategy for investing in the PPS. The study is designed for answering the question: What strategy had been good to follow over the studied time period of 2000-2011? The methods we use are related to the methods used when studying equity risk premium, where the focus is on long-term returns on securities. We are focused on long-term return and not on accounting for risk in our selection of funds.

One researcher that also uses a similar approach and tests this type of investment criteria is Estrada (2010). He compares the criteria of maximizing

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<sup>2</sup> Around 50 percent of the funds have day three as first day of trade and the reset day four.

terminal wealth with maximization of risk-adjusted returns, measured by the Sharpe ratio, as the basic criteria for portfolio selection. He finds that the criteria of maximizing terminal wealth creates portfolios that are less diversified, have higher volatility and that these portfolios tend to achieve their goal, and that those built to maximize risk-adjusted returns often do not. He also concludes that the longer time horizon is, the more attractive is a criteria focusing on terminal wealth.

#### *First set of tests*

In the first set of tests the funds are selected from the historical return of the last 30 calendar days. Portfolios are constructed with an equal amount of the five funds with the highest and lowest returns. Five funds are used since this is what is allowed in PPS. The holding periods we tests are 30 days, 60 days, 90 days, 180 days and 365 days. After each holding period the portfolios are rebalanced and the five funds with the best and worst 30-days return are selected. Since we are comparing 365 days with the other time horizons, the first possible date of the index is September 21, 2001 and the end date of the index is September 28, 2011.

### *Second set of tests*

In the second tests the funds are selected from the historical return of the same length as the holding period. For example, if the holding period is 90 calendar days the historical return of the last 90 calendar days is used. Portfolios are constructed with equal amount of the five funds with the highest and lowest return. The holding periods we tests are 30 days, 60 days, 90 days, 180 days and 365 days. After each holding period the portfolios are rebalanced and the five funds with the best (worst) return over the same historical period as the holding period are chosen.

### *Third set of tests - measuring the risk*

The strategies that we test are very simple since they only chose funds with the highest return. Here we are reasoning that being an active investor in this system aiming at accumulating wealth over a very long time period you need to expose yourself for risk. There are a number of other strategies that could be tested but we focus on momentum. We handle some of the risk exposure by using five funds, which are the maximum number allowed in PPS and could be viewed as a reasonable number for the investors in the system. The strategy exposes the investor for the risk in the market. We realize that risk is very important when investing in mutual funds; therefore we calculate what levels of risk the tested strategies give. Risk is measured as standard deviation. We are measuring risk using monthly returns.

#### *Fourth set of tests*

Often investors are advised to have a “Stop-Loss” rule when investing in securities. The rule is to sell securities when the value has decreased by a certain percentage, typically 5-10 percent. This type of rule could be used in different ways, but according to Malkiel (2007), an investor will not benefit from this rule. We use the rule as a way to limit the amount of capital that can be lost due to a sudden large decrease in value. In this study a test is performed on two different levels of “Stop-Loss”, 7.0 percent and 15 percent. If the value of the portfolio decreases with 7 or 15 percent the whole portfolio is liquidated and new funds are bought. After the new funds have been bought the holding period is the original one.

## **5 Results**

Results obtained in the tests are somewhat unexpected. We expected to see momentum but not as strong as we got. When we use 30 calendar days as measuring period for fund performance we find that a holding period of 30 days generate an increase in the index from 1 to 4.05 over the period from 2001-09-21 to 2011-09-28. See Table 2. Since we want to compare the different strategies with each other, our comparison starts September 21, 2001 when we have data for a measuring period of 365 days. The 30 days strategy would have

been possible to use earlier before September 21, 2001. As we can see in Table 2 the best results are obtained by forming a portfolio of the 5 best funds and holding them for 30 calendar days. If one invested 1000 SEK September 21, 2001 the amount would have grown to 4050 SEK September 28, 2011. Longer holding periods yield lower increases in the index. With a one year holding period one loses all effects of momentum. For 60 days the index ends up being 3.64, for 90 days 2.55, for 180 days 2.22 and for 365 days 1.13.

Contrarian strategies are not working for short time horizons as can be seen with index values of 0.70 (30 days) and 0.66 (90 days) respectively. But for 180 and 365 days with index values of 1.61 and 3.41 respectively, a gain in value of invested funds is obtained. Regarding the 60 days holding period and the value 3.37 it is clear that this is a value much larger than expected. We start holding the portfolio in September 2001 and rebalance within 60 days. It means that we are starting and rebalancing in an extreme period with very low stock market values. This explains the value of 3.37.

To see if the measurement period is important we test different measurement periods. We use the same holding period as measurement period. Our results show that this strategy is not as good as the one with a 30 calendar day measurement period. For a holding period of 30, 60, 90, 180 and 365 calendar days we get index values of 4.05, 2.51, 1.90, 1.43 and 2.04 respectively. The ending index values are lower than for the first strategy we tested but for a holding period of 365 days it is twice as high.



Testing different measurement periods on the contrarian strategy give low values for shorter periods values of 0.70, 0.99, 0.93 respectively, but for 180 and 365 days the index values are 1.68 and 1.47. See Table 3.

### *Measuring risk*

The strategies we are testing select funds based on best historical return. Risk is not considered at all in this study. Normally risk is very important when one decides on a portfolio of mutual funds. To see what risk the strategies represent we measure risk in the form of standard deviation. The risk is around 20-25 % expressed as annual standard deviation measured on monthly returns, except for a measurement and holding period of 180 days. For that period it is 89 %. See Table 4. Inspecting the whole return series for 180 days we can see that from the beginning of 2008 to the end date, the portfolios of mutual funds have had very high standard deviations with this strategy. This explains the high standard deviation for this return series.

### *Results with a Stop-Loss function*

As can be seen in Table 5, a Stop-Loss function with a 7 % loss limit increases the return for the strategy with a measurement and holding period of 30 days from 4.05 to 6.79. With a limit of 15 % the difference is not that big. It generates in some cases lower end values than without such a function.

### *Comparing our results with a indices*

We compare our results with three indices, MSCI Sweden, MSCI World and PPS index<sup>3</sup>. Since the investors in the system normally invest in Swedish assets we use MSCI Sweden as one index to compare with. We also use MSCI World because many funds are investing outside Sweden and it means that the investors could invest world-wide. We also use the PPS index provided by the Swedish Pension Authority showing the overall performance for all funds.

If we compare our momentum strategies with the performance of PPS funds we can see that there is a very big difference, especially after October 2008. The explanation of this is that many investors in PPS do not change funds at all. This is documented in a study by Dahlquist and Martinez (2012) where they conclude that pension investors in PPS do not seem to react to past fund performance. If we compare PPS with the two MSCI indices MSCI World has the same development as PPS, which is reasonable since the funds in PPS to great extent covers the whole world. MSCI Sweden has the worst performance before the October 2008 but afterwards it performs better than both PPS and MSCI World. The key question is if the momentum strategies are much more risky than other strategies. Since they have an annual standard deviation of 25 percent which is in line with the risk in the stock market we conclude that the risk is not

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<sup>3</sup> MSCI Sweden - MSCI Sweden (Mid, Large-cap, net-values) tracks a portfolio of the largest mid to large-cap stocks in the Swedish stock market. MSCI World - MSCI World (net-values) tracks a portfolio of over 6000 stocks in developed markets world-wide and is commonly used as a benchmark for global investments. PPS (PPM in Swedish) - This data is published by the Swedish Pension Authority and shows the average return for the investments made by individuals in the pension system since the start of the system. *MSCI and the Swedish Pension Authority*.

considerable greater than with other strategies. The riskiest strategy must be to do nothing which is a behavior which is well documented in research (Dahlquist and Martinez 2012) and frequently noted in the public press in Sweden.

## **6 Conclusion and further research**

The aim of this study was to test if the momentum and contrarian strategies had given a positive return in the Swedish Premium Pension System over the period it has existed. To give our test a more general meaning we tested with the fees investors outside the system pays. Since the fees investors in PPS pays are much lower, returns for investors within PPS would have been better than presented here.

Our results are in line with earlier research that document momentum in mutual fund performance (Grinblatt, Titman, and Wermers 1995, and Carhart 1997). The best strategy for investors in the PPS and other investors would have been strategy with 30 calendar day's measurement period and a holding period of 30 calendar days together with a Stop-Loss function gives an increase in the return index value from 1.0 to 6.79. In other words; 1000 SEK invested September 21, 2001 grow to 6790 SEK, September 28, 2011. Note that the increase in average return for investors in PPS over the same period has been around 20 percent. A positive effect of using this type of strategy is that the investor will be much more active and that would make a higher return more probable.

Furthermore it can be concluded that a measurement period of 30 calendar days gives better result than longer measurement periods. Momentum effects seem to be short lived in our study, which is in line with earlier research (Bollen

and Busse 2004). A contrarian strategy does not give a positive result with short holding periods, but seems to give positive return on 180 and 365 calendar days.

The results presented here are sensitive to the starting point since we are using an index with a starting value. This means that the result could be somewhat different with a different starting point but the general conclusion that a 30 calendar day measurement and holding period gives a very good return on a long investment horizon still holds. The study needs to be expanded and probed for more robust results. Next step would be to check the results for the mean of starting on each of the first 30 calendar days. Furthermore, the mutual funds in the best strategies will be documented and presented. Of particular interest is to study when the Stop-Loss function is activated and what new funds are bought then.

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**Table 1. Funds in the Swedish Premium Pension System 2000-2012.**

Number of funds and percentage in each main category. There are several sub-categories.													
Fixed income funds invest in short-term and long-term fixed income instruments.													
Mixed funds invest both in fixed income and stocks.													
Generation funds are directed towards individual in a certain age group.													
Funds for young investors are investing a large portion in stocks and funds for investors close to retirement are investing mainly in fixed income instrument and a small portion of stocks.													
Stock funds invest in stocks. Source: Swedish Pension Authority.													
							Year						
<b>Category</b>	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fixed income	65	102	115	134	138	132	137	142	131	118	129	120	120
Mixed funds	47	52	61	59	57	55	59	53	54	59	61	77	77
Generation funds	38	39	39	39	43	31	32	32	32	37	37	36	36
Stock funds	311	426	487	563	586	579	611	627	654	631	637	573	573
Total	461	619	702	795	824	797	839	854	871	845	864	806	806



**Table 2: Test of momentum and contrarian strategies on funds in the Swedish Premium Pension System**

Funds are selected from the historical return of the last 30 days.					
Equal amounts of the five funds with the highest and lowest return.					
Index starting at 1.0 2001-09-21 and end 2011-09-28.					
		Holding period calendar days			
Fund selection	30	60	90	180	365
		Index end values			
Top 5	4.05	3.64	2.55	2.22	1.13
Bottom 5	0.7	3.37*	0.66	1.61	3.41
* This value is dependent on the starting date for the index. And that the rebalancing of the portfolio takes place during a very special period with a depressed market					

**Table 3: Test of momentum and contrarian strategies on funds in the Swedish Premium Pension System**

In the second set of tests the funds are selected from the historical return of the same length as the holding period.					
Equal amounts of the five funds with the highest and lowest return.					
Index starting at 1.0 2001-09-21 and end 2011-09-28.					
		Holding period calendar days			
Fund selection	30	60	90	180	365
		Index end values			
Top 5	4.05	2.51	1.90	1.43	2.04
Bottom 5	0.70	0.99	0.93	1.68	1.47

<b>Table 4: Risk of strategies in first and second test</b>					
In our test we have not accounted for risk.					
Therefore we measure what level of risk the tested strategies give.					
Risk is measured as standard deviation.					
Risk is measured on monthly returns					
expressed as annual standard deviation.					
		Holding period calendar days			
Fund selection	30	60	90	180	365
		First set of test			
		Standard deviation			
Top 5	21%	23%	23%	25%	24%
Bottom 5	25%	22%	25%	21%	18%
		Second set of test			
		Standard deviation			
Top 5	21%	23%	24%	89%	22%
Bottom 5	25%	25%	27%	23%	22%

<b>Table 5: Test of momentum and contrarian strategies on funds in the Swedish Premium Pension System. Using a Stop-Loss function</b>					
In this study a test is performed on two different levels of stop-loss, 7 percent and 15 percent. If the value of the portfolio decreases with 7 or 15 percent the whole portfolio is liquidated and new funds are bought. After the new funds have been bought the holding period is the original one.					
SL = Stop-Loss					
	Holding period calendar days				
Fund selection	30	60	90	180	365
	Index end values				
Top SL 7	6.79	3.21	3.10	2.15	1.85
Bottom SL 7	0.52	1.04	0.71	1.25	0.83
Top SL 15	3.26	3.38	2.94	1.53	2.09
Bottom SL 15	0.61	1.49	0.76	0.55	0.97

**Figure 1: Comparing Strategy Top 30/30 and Top 30/30 with a Stop-Loss function of 7% with MSCI Sweden, MSCI World and PPS.** In this figure the most successful strategies are compared with three indices that are of interest for investors in PPS. The two strategies do not contain the same portfolios since the start of the study was September 2000. The big difference between the indices occurs after October 2008 when the momentum strategies have a great return. MSCI Sweden - MSCI Sweden (Mid, Large-cap, net-values) tracks a portfolio of the largest mid to large-cap stocks in the Swedish stock market. MSCI World - MSCI World (net-values) tracks a portfolio of over 6000 stocks in developed markets world-wide and is commonly used as a benchmark for global investments. PPS (PPM in Swedish) - This data is published by the Swedish Pension Authority and shows the average return for the investments made by individuals in the pension system since the start of the system.

Source: Indices, MSCI and the Swedish Pension Authority.

