FHS St.Gallen
Hochschule
für Angewandte Wissenschaften

LAPIS ASSET MANAGEMENT Ltd

RISK-RETURN ANALYSIS OF PASSIVE INVESTMENT STRATEGIES (SUMMARY)

Bachelor thesis
on behalf of Lapis Asset Management Ltd

FHS St.Gallen
Hochschule
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1 Introduction

Lapis Asset Management Ltd's strategies are based on passive investment instruments (Exchange Traded Funds, ETFs). The four investment categories equities, bonds, real estate and commodities cover the entire investment universe and are therefore at the heart of every asset allocation. The Lapis Core Portfolio invests to the same degree in all four asset classes, so that there is no underweight or overweight in any asset class. This also ensures that the client's assets are always invested in the asset class that demonstrates the best possible performance. The company holds the allocation constant through rebalancing, which means that an individual asset class is not overweight despite a better performance. (Lapis Asset Management Ltd, no date a)

A risk analysis is carried out in the following for selected global indices of the four asset classes and the ETFs listed that map these indices. The same analysis is carried out for the Lapis Core Portfolio. Probabilities of the Lapis Core Portfolio are further calculated and a correlation analysis produced between the returns of this investment strategy and selected economic influencing factors.

2 Risk-return analysis per asset class

A risk-return analysis of the asset classes equities, bonds, real estate and commodities is carried out in this section. This shows the average discrete yields, volatility per annum and the Sharpe ratio of the analysed indices over the last two, five and ten years. In addition, the development since the indices started to be calculated is highlighted. The financial ratios from the last stock exchange price taken into account (as per 29 March 2013) backdated over the entire term of whole quarters are ascertained. The weekly stock exchange prices of the indices are the calculation basis of these financial ratios. It is assumed that all the characteristic values are normally distributed. There is no allowance for inflation rates. These are therefore nominal returns in each case. Furthermore, ETFs are listed, with which an investor is able to invest in the each index. The index names are abbreviated in the tables with the Bloomberg ticker (see Appendix A for the full name of the index).

2.1 Asset class equities

The asset class equities analyses the global indices in which the appreciation of equity markets is measured in both developed countries and in emerging markets. Tab. 1 shows the risk/return analysis over two, five and ten years. The four analysed indices are performance-based and free-floating market-capitalising weighted indices that are calculated in US dollars (Bloomberg L.P., 2013; MSCI Inc., no date; State Street Global Advisors Limited [SSgA], no date a; SSgA, no date b; Vanguard Investments Switzerland GmbH, no date).

	MIMUAWON	NDUEACWF	M1WD	TAWNT01U
Average annual return over 2 years	4.42%	4.44%	4.45%	4.34%
Volatility p.a. over 2 years	18.14%	17.98%	17.98%	17.99%
Average annual return over 5 years	1.83%	1.30%	1.30%	1.43%
Volatility p.a. over 5 years	24.26%	24.16%	24.16%	24.17%
Average annual return over 10 years	9.55%	9.03%	9.03%	
Volatility p.a. over 10 years	19.31%	19.20%	19.20%	

Tab. 1: Risk/return analysis of the asset class equities.

Source: own calculation based on Bloomberg L.P. (2013).

The returns and volatilities of the global equity indices in Tab. 1 show a similar course over the investigated periods. NDUEACWF and M1WD Index are similar indices and have undergone a parallel development since the end of December 2000, as the value of each stood at 100 points at this time The average annual returns and volatilities p.a. over the five years is lower and higher compared with the periods over two and ten years. The impact of the financial crisis is shown here, at which the equity markets have fallen and volatilities have risen because of uncertainties.

In Tab. 2, it is possible to see the analysis of the same financial ratios over the entire term and the discrete total return since the indices were calculated.

	MIMUAWON	NDUEACWF	M1WD	TAWNT01U
Calculated since	Jan 1995	Jan 1999	Dec 2000	Sept 2003
Analysed period	18.25 years	14.25 years	12.25 years	9.5 years
Average annual return	6.70%	3.79%	3.78%	7.20%
Volatility p.a.	17.57%	18.71%	19.20%	19.47%
Total return since calculation	226.81%	69.82%	57.63%	93.66%

Tab. 2: Risk/return analysis of the asset class equities since calculation.
Source: own calculation based on Bloomberg L.P. (2013).

If you view the total return since calculation, though not the volatility per annum, it is possible to see that the TAWNT01U Index achieved a higher total return within a shorter space of time than the NDUEACWF and the M1WD Index. However, other factors that should be considered include the dotcom bubble in 2000 and the terrorist attacks of 11th September, 2001, which were before the TAWNT01U Index was calculated. The average, most profitable period of the MIMUAWON, NDUEACWF and M1WD Indices is over ten years (see Tab. 1), and for the TAWNT01U Index over 9.5 years (cf. Tab. 2).

Tab. 3 shows the Sharpe ratio of the equity indices over two, five and ten years.

	MIMUAWON	NDUEACWF	M1WD	TAWN01U
Sharpe ratio over 2 years	0.19	0.20	0.20	0.19
Sharpe ratio over 5 years	0.02	-0.01	-0.01	0.00
Sharpe ratio over 10 years	0.38	0.35	0.35	

Tab. 3: Sharpe ratio of the equity indices.
Source: own calculation based on Bloomberg L.P. (2013).

Tab. 3 shows that the individual equity indices demonstrate a similar or the same Sharpe ratio over all time periods. The maximum Sharpe ratio results over the period of ten years, followed by the period over two years. There is no additional compensation for the risk taken over the period of five years. Thus, it made no difference whether the capital was invested in one of the indices or in a replicating ETF or in a risk-free investment (in this case ten-year Swiss government bonds).

For investors, it is possible to invest in the analysed equity indices with the following ETFs (see Tab. 4).

Index	ETF	ISIN	ETF currency
MIMUAWON	SPDR® MSCI ACWI IMI UCITS ETF	IE00B3YLTY66	USD
NDUEACWF	iShares MSCI ACWI UCITS ETF	DE000A1JS9A4 / IE00B6R52259	USD
	SPDR® MSCI ACWI UCITS ETF	IE00B44Z5B48	USD
M1WD	Lyxor ETF MSCI All Country World	FR0011079466	EUR
TAWNT01U	Vanguard FTSE All-World ETF	IE00B3RBWM25	USD

Tab. 4: ETFs for the asset class equities.
Source: based on BlackRock Asset Management Deutschland AG (no date), Lyxor Asset Management (no date a), SSgA (no date a), SSgA (no date b), Vanguard Investments Switzerland GmbH (no date).

2.2 Asset class bonds

The asset class bonds analyses indices that measure the growth of US government bonds with a residual term of at least three and a maximum of seven years. Tab. 5 shows the risk/return analysis over two, five and ten years. The analysed indices are performance indices that are calculated in USD (Amundi ETF, no date; BlackRock Asset Management Schweiz AG, no date a; Bloomberg L.P., 2013; Credit Suisse AG, no date; Lyxor Asset Management, no date b).

	IULT37TR	IBOXPHA7	LT13TRUU	ITRR5T7
Average annual return over 2 years	5.34%	5.35%	5.34%	7.04%
Volatility p.a. over 2 years	3.02%	3.04%	3.03%	4.13%
Average annual return over 5 years	4.69%		4.72%	5.56%
Volatility p.a. over 5 years	4.14%		4.24%	5.34%
Average annual return over 10 years	4.11%		4.64%	5.28%
Volatility p.a. over 10 years	3.87%		4.03%	4.68%

Tab. 5: Risk/return analysis of the asset class bonds.
Source: own calculation based on Bloomberg L.P. (2013).

The IULT37TR, the IBOXPHA7 and the LT13TRUU Index measure the growth of US government bonds with residual terms of three to seven years. The residual term of the US bonds contained within the ITRR5T7 Index is either between five and seven or three years (Lyxor Asset Management, no date b). Based on Tab. 5, this index has higher returns over the investigated periods than the remaining three. At the same time, the volatility per annum is higher in each case. The IULT37TR and the LT13TRUU Index follow a similar course over two and five years; the LT13TRUU Index has an average return of 0.53 percentage points more over ten years. For all the indices, the average annual returns are higher the shorter the period under review.

Tab. 6 shows the risk/return analysis of the asset class bonds over the entire term of the index.

	IULT37TR	IBOXPHA7	LT13TRUU	ITRR5T7
Calculated since	Jan 1999	Sept 2010	Jan 1992	Jan 1999
Analysed period	14.25 years	2.5 years	21.25 years	14.25 years
Average annual return	4.88%	3.24%	6.05%	5.89%
Volatility p.a.	3.95%	3.39%	4.16%	4.74%
Total return since calculation	97.13%	8.31%	248.42%	126.18%

Tab. 6: Risk/return analysis of the asset class bonds since calculation.
Source: own calculation based on Bloomberg L.P. (2013).

As in the investigated periods in Tab. 5, the ITRR5T7 Index also has higher average annual returns over the entire term and shows a higher volatility per annum than the IULT37TR Index. The entire return since calculation is 29.05 percentage points higher. The LT13TRUU Index achieved a higher average annual return over the entire term than over two years, as the only index of this asset class. The average most profitable period of the remaining indices is that over two years, simultaneously at the lowest volatility per annum (see Tab. 5).

The Sharpe ratio of the bond indices can be seen over two, five and ten years in Tab. 7.

	IULT37TR	IBOXPHA7	LT13TRUU	ITRR5T7
Sharpe ratio over 2 years	1.45	1.45	1.45	1.45
Sharpe ratio over 5 years	0.76		0.76	0.75
Sharpe ratio over 10 years	0.56		0.66	0.70

Tab. 7: Sharpe ratio of the bond indices.
Source: own calculation based on Bloomberg L.P. (2013).

Based on Tab. 7, all the bond indices over each of the periods under review have achieved an excess return per percentage point of volatility. The Sharpe ratio over two and five years demonstrates the same progression for all indices, with the maximum being that over two years. The ITRR5T7 Index achieves the maximum Sharpe ratio over ten years. It has therefore been worthwhile for investors to take risk in all indices. This means that an investment in

one of the indices or in a replicating ETF was more beneficial than in an investment free from risk (in this case, the ten-year Swiss government bond).

An investment into the analysed bond indices is possible with the following ETFs (see Tab. 8).

Index	ETF	ISIN	ETF currency
IULT37TR	AMUNDI ETF US TREASURY 3-7	FR0010892299	USD
IBOXPHA7	CS ETF (IE) on iBoxx USD Govt 3-7 (since 01.07.2013 iShares USD Government Bond 3-7 UCITS ETF (Acc))	IE00B3VWN393	USD
LT13TRUU	iShares 3-7 Year Treasury Bond ETF (IEI)	US4642886612	USD
ITRR5T7	Lyxor ETF iBoxx $ Treasuries 5-7Y	FR0010961011	USD

Tab. 8: ETFs for the asset class bonds.
Source: based on Amundi ETF (no date), BlackRock Asset Management Schweiz AG (no date a), Credit Suisse AG (no date), Lyxor Asset Management (no date b).

2.3 Asset class real estate

The global indices analysed in the asset class real estate measure the development of limited companies quoted on the stock market that operate in the real estate sector. These property companies include real estate investment trusts (REITs). The limited companies included in the analysed indices generally have or manage commercial property; the proportion of residential real estate is a maximum of ten percent of total volume.

Tab. 9 shows the risk/return analysis of the asset class property over two, five and ten years. The TRNGLU Index is a performance index and weighted according to the market capitalisation. The TENGDNU, RUGL and DWGRSN Indices are also performance indices that are weighted according to the free-float market capitalisation. They are all calculated in USD. (BlackRock Asset Management Schweiz AG, no date b; Bloomberg L.P., 2013; First Trust Portfolios L.P., no date; Lyxor Asset Management, no date c; SSgA, no date c)

	TENGDNU	TRNGLU	RUGL	DWGRSN
Average annual return over 2 years	10.39%	10.86%	11.64%	11.55%
Volatility p.a. over 2 years	17.40%	17.78%	17.79%	17.84%
Average annual return over 5 years	2.86%	1.70%	2.45%	2.26%
Volatility p.a. over 5 years	29.74%	28.78%	28.78%	29.56%
Average annual return over 10 years			12.90%	
Volatility p.a. over 10 years			23.00%	

Tab. 9: Risk/return analysis of the asset class real estate.
Source: own calculation based on Bloomberg L.P. (2013).

The average annual returns of the TENGDU and the TRNGLU Index show a similar development over the period of two years. The same applies to the RUGL and the DWGRSN Index (see Tab. 9). The volatility per annum shows a similar progression for all indices. Over five years the TRNGLU index demonstrates the lowest average annual return. The four indices also show a similar volatility per annum over this period. A comparison of the various periods shows that the average annual returns and the volatility per annum over five years lies lower or higher than over two and ten years. The reason for this trend lies in the outbreak of the US real estate crisis in 2007.

Tab. 10 shows the analysis of the asset class real estate over the entire term.

	TENGDNU	TRNGLU	RUGL	DWGRSN
Calculated since	Aug 2006	Feb 2005	Dec 1989	Jan 2004
Analysed period	6.5 years	8 years	23.25 years	9.25 years
Average annual return	3.04%	6.92%	8.09%	8.67%
Volatility p.a.	27.80%	24.97%	18.54%	24.21%
Total return since calculation	21.47%	70.76%	510.68%	115.86%

Tab. 10: Risk/return analysis of the asset class real estate since calculation.
Source: own calculation based on Bloomberg L.P. (2013).

All real estate indices have achieved an average lower annual return over the entire term than over two years (see Tab. 9 and 10). The average, most profitable period of the TENGDNU, TRNGLU and DWGRSN Index is over two years, while volatility per annum is at its lowest in this period. The RUGL Index, by contrast, achieves the maximum average annual return over the period of ten years. The index has achieved a lower average return per annum by 1.26 percentage points than over ten years, while the volatility per annum is 5.21 percentage points lower. Overall, the risk of the analysed global real estate indices has fallen during the last two years.

The real estate indices show the following Sharpe ratio (see Tab. 11).

	TENGDNU	TRNGLU	RUGL	DWGRSN
Sharpe ratio over 2 years	0.52	0.53	0.57	0.57
Sharpe ratio over 5 years	0.05	0.01	0.04	0.03
Sharpe ratio over 10 years			0.45	

Tab. 11: Sharpe ratio of the real estate indices.
Source: own calculation based on Bloomberg L.P. (2013).

The indices achieve an excess return per percentage point of volatility over the period of two years (see Tab. 11). The course of the Sharpe ratio is similar for all indices. The RUGL Index also achieves an excess return over the period of ten years, although this appears lower compared with that over two years. The investors were not compensated for the risk they entered into over the period of five years (Sharpe ratio between 0.01 and 0.05). A risk-free investment (in this case, the 10-year, Swiss government bond) would have yielded a similar level of compensation, taking the lower risk into account.

Following ETFs form the analysed real estate indices (see Tab. 12).

Index	ETF	ISIN / CUSIP	ETF currency
TENGDNU	iShares FTSE EPRA/NAREIT Developed Markets Property Yield Fund	DE000A0LGQL5 / IE00B1FZS350	USD
TRNGLU	Lyxor ETF FTSE EPRA/NAREIT Global Developed	FR0010852566	USD
	Lyxor ETF FTSE EPRA/NAREIT Global Developed	FR0010833574	EUR
RUGL	First Trust FTSE EPRA/NAREIT Developed Markets Real Estate Index Fund	33736N101	USD
DWGRSN	SPDR® Dow Jones® Global Real Estate ETF	US78463X7497	USD
	SPDR® Dow Jones Global Real Estate UCITS ETF	IE00B8GF1M35	USD

Tab. 12: ETFs for the asset class real estate.
Source: based on BlackRock Asset Management Schweiz AG (no date b), First Trust Portfolios L.P. (no date), Lyxor Asset Management (no date c), Lyxor Asset Management (no date d), SSgA (no date c), SSgA (no date d).

2.4 Asset class commodities

The asset class commodities analyses indices that measure the growth of both soft and hard commodities. The risk/return analysis is shown in Tab. 13. The analysed indices are performance indices and are calculated in USD (Bloomberg L.P., 2013; Lyxor Asset Management, no date e; The Royal Bank of Scotland plc, no date; UBS ETFs plc, no date a; UBS ETFs plc, no date b).

	RICIGLTR	CRYTR	DJUBSTR	CMCITR
Average annual return over 2 years	-7.09%	-9.31%	-10.02%	-6.69%
Volatility p.a. over 2 years	17.70%	16.28%	16.76%	15.64%
Average annual return over 5 years	-5.75%	-5.32%	-7.39%	-2.84%
Volatility p.a. over 5 years	24.58%	22.41%	21.41%	21.69%
Average annual return over 10 years	7.57%	5.69%	3.75%	12.35%
Volatility p.a. over 10 years	20.96%	19.57%	19.10%	18.35%

Tab. 13: Risk/return analysis of the asset class commodities.

Source: own calculation based on Bloomberg L.P. (2013).

Tab. 13 shows that all commodity indices have achieved negative average annual returns over the last two and five years, with the negative returns being higher over two years than over five years. Conversely, the volatility per annum of all indices over two years is lower than over five years. The indices show a positive average annual return over ten years. The negative average returns of the CMCITR index over two and five years are below, and the positive average returns over ten years above those of the remaining three indices. At the same time, volatility per annum of this index is lowest over two and ten years. The DJUBSTR Index achieves the maximum negative yield or the lowest average annual return compared with the other indices.

Tab. 14 shows the risk/return analysis of the asset class commodities since the calculation.

	RICIGLTR	CRYTR	DJUBSTR	CMCITR
Calculated since	Jul 1998	Jan 1994	Jan 1991	Oct 1997
Analysed period	14.5 years	19.25 years	22.25 years	15.5 years
Average annual return	9.44%	8.19%	4.92%	9.23%
Volatility p.a.	19.75%	16.78%	15.13%	16.06%
Total return since calcula-tion	270.01%	354.76%	191.04%	292.85%

Tab. 14: Risk/return analysis of the asset class commodities since calculation.
Source: own calculation based on Bloomberg L.P. (2013).

With the exception of the CMCITR Index, all indices have achieved a higher annual return on average over the entire term than over the period of ten years (see Tab. 13 and 14). The DJUBSTR Index is calculated over the longest period and yet has the lowest overall return.

The reason for the different returns lies in the differences in the commodity and sector weightings of the individual indices. For example, industrial metals behave differently to agricultural products. The diversification of the term of futures plays a role for the index trend, particularly because of the contango and backwardation. (Béguelin, 2013)

Tab. 15 shows the Sharpe ratio of the commodity indices over two, five and ten years.

	RICIGLTR	CRYTR	DJUBSTR	CMCITR
Sharpe ratio over 2 years				
Sharpe ratio over 5 years				
Sharpe ratio over 10 years	0.26	0.19	0.09	0.53

Tab. 15: Sharpe ratio of the commodity indices.
Source: own calculation based on Bloomberg L.P. (2013).

As the average annual returns over two and five years are negative for all commodity indices (see Tab. 13), the Sharpe ratio is not included over both these periods in Tab. 15. Over the period of ten years, the investors were compensated for the risk they took, with this compensation being at its lowest for the DJUBSTR Index. The CMCITR Index achieves the maximum excess return per percentage point of volatility.

The analysed commodity indices represent the following ETFs or ETCs (see Tab. 16).

Index	ETF / ETC	ISIN	ETF currency
RICIGLTR	RBS Market Access Rogers International Commodity Index® ETF	LU0249326488	EUR
CRYTR	Lyxor ETF Commodities Thomson Reuters/Jefferies CRB TR	FR0010270033	EUR
	Lyxor ETF Commodities Thomson Reuters/Jefferies CRB TR (USD)	FR0010318998	USD
DJUBSTR	UBS ETFs plc – DJ-UBS Commodity Index SF (USD) A-acc	IE00B5B3W843	USD
CMCITR	UBS ETFs plc – CMCI Composite SF (USD) A-acc	IE00B53H0131	USD
	UBS ETC on UBS Bloomberg CMCI Composite Index	CH0031794263	USD

Tab. 16: ETFs for the asset class commodities.
Source: based on Lyxor Asset Management (no date e), Lyxor Asset Management (no date f), The Royal Bank of Scotland plc (no date), UBS AG (no date), UBS ETFs plc (no date a), UBS ETFs plc (no date b).

3 Risk/return analysis of the Lapis Core Portfolio

A risk/return analysis of the Lapis Core Portfolio is carried out in Section 3. Section 3.1 explains in what asset classes this strategy is invested. The analysis of risks and the returns over two, five and ten years and since the strategy was calculated then follows in Section 3.2. The analysis is carried out on an annual and quarterly basis.

3.1 Weighting of the Lapis Core Portfolio

The investment strategy of Lapis Asset Management Ltd is based on passive investment instruments. This means that ETFs of the respective asset classes are acquired in order to manage the client's assets. The Lapis Core Portfolio invests up to 25 percent in the asset classes equities, bonds, real estate and commodities. Lapis Asset Management Ltd manages the portfolio in the reference currencies CHF, EUR, GBP, SGD, USD and YEN according to the client's request. The weighting of the asset classes is investigated independently of performance in this period after each quarter and the original allocation is rebalanced. (Lapis Asset Management Ltd, no date b)

3.2 Analysis of the Lapis Core Portfolio

This subsection shows the results of the risk/return analysis of the Lapis Core Portfolio over two, five and ten years and since the strategy was calculated on an annual and quarterly basis. The analysis of the entire period takes account of performance between 1st July 1998 and 31st March 2013. This equates to 14.75 years or 59 quarters. It is assumed that all the characteristic values are normally distributed. There is no allowance for inflation rates. These are therefore nominal returns in each case. The basis for calculating these financial ratios are the portfolio's exchange rates at the end of the quarter.

Tab. 17 shows the risk/return analysis of the Lapis Core Portfolio on an annual basis.

	Lapis Core Portfolio
Average annual return over 2 years	3.93%
Volatility p.a. over 2 years	11.74%
Average annual return over 5 years	3.09%
Volatility p.a. over 5 years	18.60%
Average annual return over 10 years	10.72%
Volatility p.a. over 10 years	14.16%
Average annual return over 14.75 years	8.55 %
Volatility p.a. over 14.75 years	12.47%
Total return since calculation	235.45%

Tab. 17: Risk/return analysis of the Lapis Core Portfolio on an annual basis
Source: own calculation based on Lapis Asset Management Ltd (no date b).

As can be seen in Tab. 17, the most profitable period on average for the Lapis Core Portfolio is that over ten years. The portfolio shows similar average returns over the periods of two and five years, whereas the volatility per annum is lower over two years. The remaining periods each show a higher volatility per annum, which means that the risk of the Lapis Core Portfolio has fallen during the past two years.

The risk/return analysis on a quarterly basis is visible from Tab. 18.

	Lapis Core Portfolio
Average quarterly return over 2 years	0.97%
Volatility per quarter over 2 years	5.87%
Average quarterly return over 5 years	0.76%
Volatility per quarter over 5 years	9.30%
Average quarterly return over 10 years	2.58%
Volatility per quarter over 10 years	7.08%
Average quarterly return over 14.75 years	2.07%
Volatility per quarter over 14.75 years	6.24%

Tab. 18: Risk/return analysis of the Lapis Core Portfolio on a quarterly basis
Source: own calculation based on Lapis Asset Management Ltd (no date b).

As regards the course of returns and volatilities over the various time periods, Tab. 18 should be interpreted as Tab. 17.

Tab. 19 shows the Sharpe ratio of the Lapis Core Portfolio over two, five, ten and 14.75 years (on an annual basis, see returns and volatilities in Tab. 17).

	Lapis Core Portfolio
Sharpe ratio over 2 years	0.26
Sharpe ratio over 5 years	0.09
Sharpe ratio over 10 years	0.59
Sharpe ratio over 14.75 years	0.48

Tab. 19: Sharpe Ratio of the Lapis Core Portfolio.
Source: own calculation based on Bloomberg L.P. (2013) and Lapis Asset Management Ltd. (no date b).

The results in Tab. 19 indicate that the Lapis Core Portfolio has achieved an excess return per percentage point of volatility, over every period. The maximum Sharpe ratio is given over the period of ten years. The average annual return is the highest over this period. The risk taken is rewarded least over the last five years, as the volatility per annum is the highest in this period and the average annual return is the lowest. As the risk of the Lapis Core Portfolio has fallen over the past two years, the Sharpe ratio has risen compared with the period over five years.

4 Probability of losses of the Lapis Core Portfolio

This section calculates the probability of default and losses of the Lapis Core Portfolio based on historical data. The measures of risk shortfall risk and value at risk serve to calculate these figures. The analyses of these two measures of risk can be seen in Section 4.1 and 4.2. The future-based simulation for loss probabilities follows in Section 4.3.

4.1 Shortfall risk of the Lapis Core Portfolio

This subsection calculates the probability that the Lapis Core Portfolio falls short of the minimum returns of -5.0, 0 and 5 percent. The constant, average annual returns and volatility per annum over 14.75 years are used for the calculations. Including the entire period permits more reliable conclusions. The average constant return over 14.75 years is 8.21 percent, the volatility per annum in this period stands at 12.47 percent.

There is the following shortfall risk on an annual basis for the Lapis Core Portfolio (see Tab. 20), using this data

	Minimum return		
	-5%	0%	5%
Shortfall risk Lapis Core Portfolio	14.47%	25.51%	39.84%

Tab. 20: Shortfall risk of the Lapis Core Portfolio
Source: own calculation based on Lapis Asset Management Ltd (no date b).

As can be seen in Tab. 20, the Lapis Core Portfolio with a shortfall risk of 25.51 percent fails to achieve a positive minimum return in every fourth year. The portfolio achieves an annual loss of over 5.0 percent in around three of 20 years (shortfall risk 14.47 percent). For a set minimum return of 5.0 percent the shortfall risk is 39.84 percent. For an investor, a return of less than 5.0 percent is the result in around every third year.

4.2 Value at risk of the Lapis Core Portfolio

This subsection investigates the value at risk of the Lapis Core Portfolio. It illustrates how high the loss is within a year that is not exceeded for a CHF 100,000 investment with a probability of 95 percent. The expected value and the volatility per annum from Section 4.1 will also be used for the value at risk.

The value at risk on an annual basis can be viewed in Tab. 21.

	Value at Risk in CHF	Residual of the portfolio after 1 year
Lapis Core Portfolio	-11,575	CHF 88,425

Tab. 21: Value at risk of the Lapis Core Portfolio.
Source: own calculation based on Lapis Asset Management Ltd (no date b).

For an investment of CHF 100,000 the amount of loss that will be exceeded within a year with a probability of five percent is CHF 11,575 for the Lapis Core Portfolio (see Tab. 21). This means that an investor continues to have at least 88.425 percent of their investment sum in the portfolio. Probability of this is 95 percent.

4.3 Future-based simulation of the Lapis Core Portfolio

The aim of this subsection is to carry out future-based simulations for the loss probabilities of the Lapis Core Portfolio for a time horizon of one and five years. The demo version of the risk and analysis software @Risk from Palisade Corporation is available for these simulations. The constant average annual returns and the volatilities per annum over 14.75 years serve as a basis (see Section 4.1).

Tab. 22 shows the results of the future-based simulation for the Lapis Core Portfolio for a holding period of one and five years.

Holding period	Average returns	p of negative returns	p of positive returns	VAR
1 year	8.56%	27.6%	72.4%	-12.26%
5 years	50.76%	9.1%	90.9%	-8.35%

Tab. 22: Simulation of the Lapis Core Portfolio
Source: own presentation, based on Lapis Asset Management Ltd (no date b) and Palisade Corporation (2013).

As Tab. 22 shows, the Lapis Core Portfolio could increase by 8.56 percent for a holding period of one year. The returns will be negative with a probability of 27.6 percent. After a year, there is a 95 percent probability that an investor will lose less than 12.26 of their investment. For a holding period of five years, there is the possibility that the Lapis Core Portfolio will achieve a total return of 50.76 percent. There is a 90.9 percent probability of a positive return. The VAR (Value at Risk) indicates that there is a 95 percent probability that the invested assets will not lose more than 8.35 percent of their value after five years.

Fig. 1 shows the histogram of the Lapis Core Portfolio for a holding period of one year. The probability of a negative return is highlighted (27.6 percent).

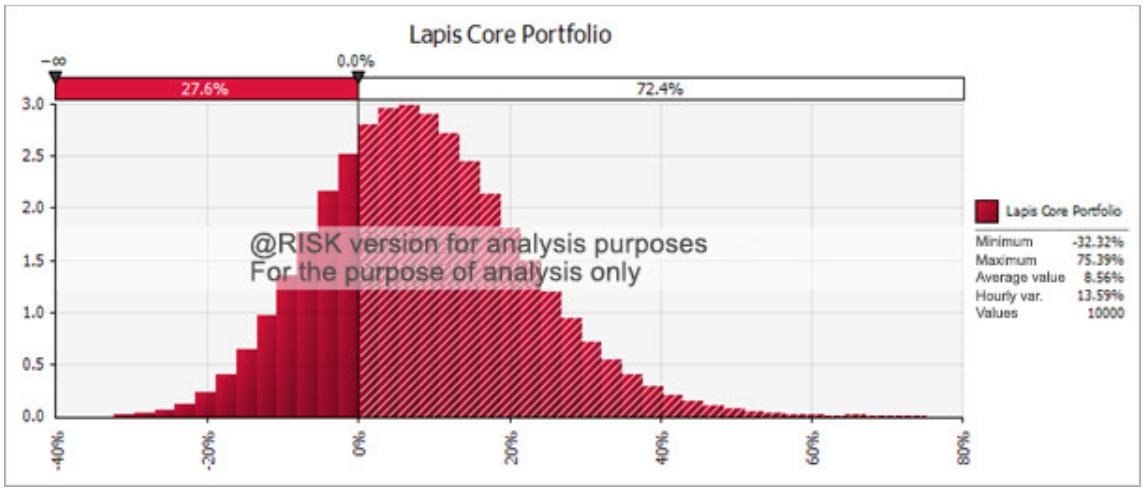

Fig. 1: Histogram of the Lapis Core Portfolio over 1 year.
Source: unchanged from Palisade Corporation (2013).

The histogram can be seen in Fig. 2 for a holding period of five years.

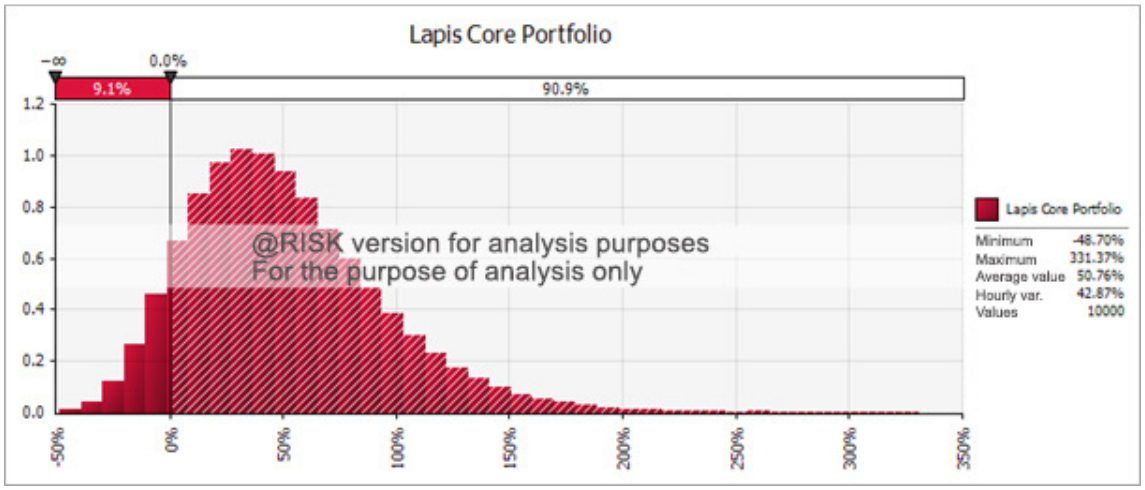

Fig. 2: Histogram of the Lapis Core Portfolio over 5 years
Source: unchanged from Palisade Corporation (2013).

5 Correlation analysis of the Lapis Core Portfolio

A correlation analysis is carried out in this section with the Lapis Core Portfolio. The analysis investigates whether there is a correlation between the returns of the strategy and the economic influencing factors of gross domestic product, inflation and short-term interest rates. The economic data of the USA is used for the analysis in each case. The correlations are measured over a period of two, five and ten and 14.75 years.

Correlation analysis

All correlation coefficients that are described in the following are no indicator of a causal link between the investigated variables. For this reason, high correlations should only be seen as an indicator of a possible link between the returns of the Lapis Core Portfolio and the economic influencing factors.

Lapis Core Portfolio	GDP	Inflation	Short-term interest
Correlation over 2 years	0.5	-0.4	0.2
Correlation over 5 years	0.7	-0.4	-0.6
Correlation over 10 years	0.7	-0.3	-0.1
Correlation over 14.75 years	0.6	-0.3	-0.1

Tab. 23: Correlation analysis of the Lapis Core Portfolio.
Source: own calculation based on Bloomberg L.P. (2013), Bureau of Economic Analysis [BEA] (no date), Lapis Asset Management Ltd (no date b), Organisation for Economic Co-operation and Development [OECD] (no date).

Based on Tab. 23, there exists a positive, moderate correlation between the returns of the Lapis Core Portfolio and the growth rates of the actual US GDP over all periods. The strongest correlation between the two variables was over five and ten years. There is a negative and weak correlation in each case between the yields of the portfolio and the US inflation rate. Just as weak, though positive, is the link between the returns of the Lapis Core Portfolio and the short-term interest rate in the US over two years. The relationship is negative and moderate over five years. There is no correlation of the two variables over ten and 14.75 years (correlation coefficient -0.1 in each case).

6 Conclusion

The risk/return analysis in Section 2 indicates that the four asset classes have performed differently over the investigated periods. The bond indices show similarly high average returns over all periods. Although this is always lower than that of the three other asset classes, the risk for bonds is the lowest. The financial crisis has had a similar impact upon the equity and real estate indices. Both asset classes show the lowest average annual returns over five years, which have risen again in the last two years. Volatility has fallen at the same time. The returns of the real estate indices have recovered better than those of the equity indices. The commodity indices performed the least favourably. Losses have continued to rise here during the past two years.

Should the central banks abandon the current zero-interest policy because of forecast rises in inflation and allow the base rates to increase once again, this could result in a loss because of the price collapse in bonds, if an investment strategy carries too high a proportion of bonds. It therefore appears sensible for medium-to-long term investments to spread the risks and therefore also the opportunities of the four asset classes evenly. For this reason, an investment in the Lapis Core Portfolio is therefore suitable in the medium and long term. This strategy spreads the risk and opportunities to the same extent as no asset class is overweight or underweight.

The simulations with the @Risk software demonstrate possible scenarios for future developments on the basis of historical data. Historic return details are no guarantee of future results. The returns can therefore appear differently to how the software demonstrates.

The correlation analysis in Section 5 has shown that there is hardly any correlation between the returns of the Lapis Core Portfolio and the economic influencing factors in the USA. There is most likely to be a link with the GDP, although it is not strong.

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Appendices

Appendix A: Index name

Equities

MIMUAWON-Index: MSCI AC World Index IMI USD Net

NDUEACWF-Index: MSCI AC World Daily TR Net USD

M1WD-Index: MSCI All Country World NR

TAWNT01U-Index: FTSE All World Net Tax TR USD

Bonds

IULT37TR-Index: Markit iBoxx USD Treasuries 3-7 TR

IBOXPHA7-Index: Markit iBoxx USD Treasuries 3-7Y (TR) (Mid) (09/10)

LT13TRUU-Index: Barclays U.S. Treasury 3-7 Yr Total Return Index Value Unhedged USD

ITRR5T7-Index: iBoxx USD Treasuries 5-7Y Total Return Index

Real estate

TENGDNU-Index: FTSE EPRA/NAREIT Developed Dividend + Net Total Return Index USD

TRNGLU-Index: FTSE EPRA/NAREIT Developed Net TRI USD

RUGL-Index: FTSE EPRA/NAREIT Developed Total Return Index USD

DWGRSN-Index: Dow Jones Global Select Real Estate Index

Commodities

RICIGLTR-Index: Rogers International Commodity Index Total Return

CRYTR-Index: Thomson Reuters/Jefferies CRB Total Return Index

DJUBSTR-Index: Dow Jones-UBS Commodity Index Total Return

CMCITR-Index: UBS Bloomberg CMCI Composite USD Total Return

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