The Future Returns of the S&P 500 Index

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Introduction

The aim of this report is to understand the probable future returns of the S&P 500 index through the analysis of historical returns.

The United States stock market has undoubtedly been the most important stock market across the world for many years now. In recent decades this statement has become even more true with many United States companies working internationally (Alphabet Inc., McDonald's Corp., Microsoft Corp. Facebook Inc., and many more). This is one of the two reasons why the United States stock market has been chosen for the analysis. Inflation has not been considered.

The index

The S&P 500 is one of the most known indices globally. It is arguably one of the best indices to track the growth of the Unites States economy, and more in particular, the United States stock market. The S&P 500 has nearly 100 years of easily available historical data (both for dividends and prices), and this is the second reason why it has been chosen over other type of indices for this report.

The S&P 500 is a price return index, the reason why the total return version has not been chosen lies, once again, in the availability of historical data.

The index is composed, as of November 14th 2020, by 505 US companies. This has not always been the number of components of the S&P 500, initially it was a 90-stock index. This is a capitalization-weighted index, this means that it is intrinsically trend following: In a capitalization-weighted index, the more the market capitalization of the stock is big, the more the company will be represented in the index, therefore if the price of a stock increases, that stock will be represented more in the index, so we can say the index strategy is trend-following.
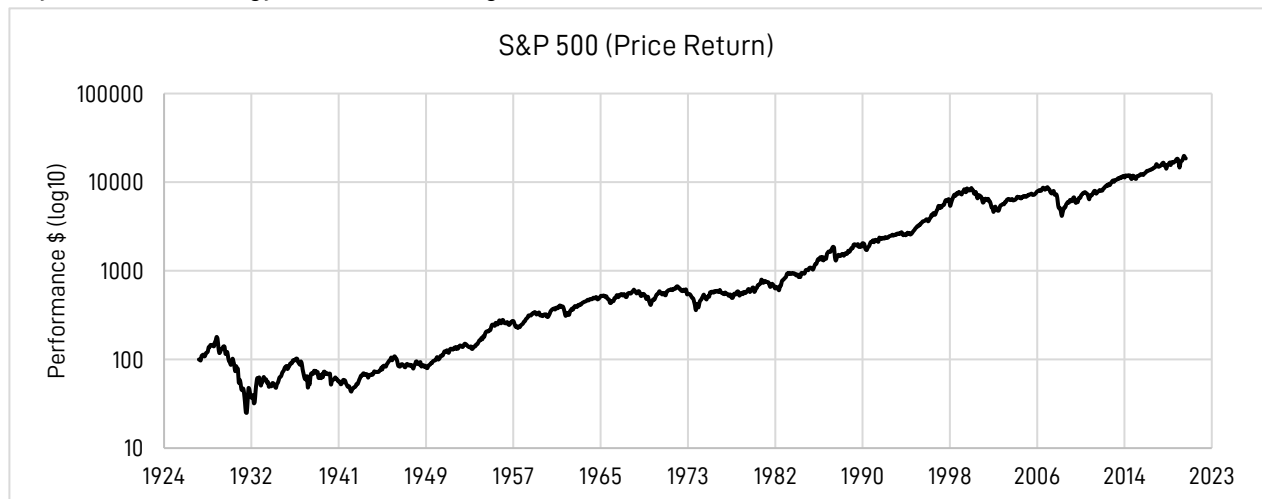

Figure 1 - Performance of a $100 investment in the S&P 500 from 01.12.1927 to 31.10.2020 – Data from finance.yahoo.com, 07.11.2020

Data used

Two sets of data from the S&P 500 index have been used: distributed dividends, and change in price. These are the only two ways by which an investor makes a profit by investing in the S&P 500. Dividends are a direct earning given to the investor, the price change delivers a capital gain (or loss) when the investment is liquidated. As stated before, it has not been possible to use a Total Return Index as there was not enough historical data to work with.

The historical returns of investments in the S&P 500

For this report 4 types of investments have been analyzed: 10-year investments, 20-year investments, 30-year investments and 40-year investments. The goal is to see how these 4 types of investments performed when started at different months. Every investment is a one-time investment, it does not therefore represent an accumulation plan.
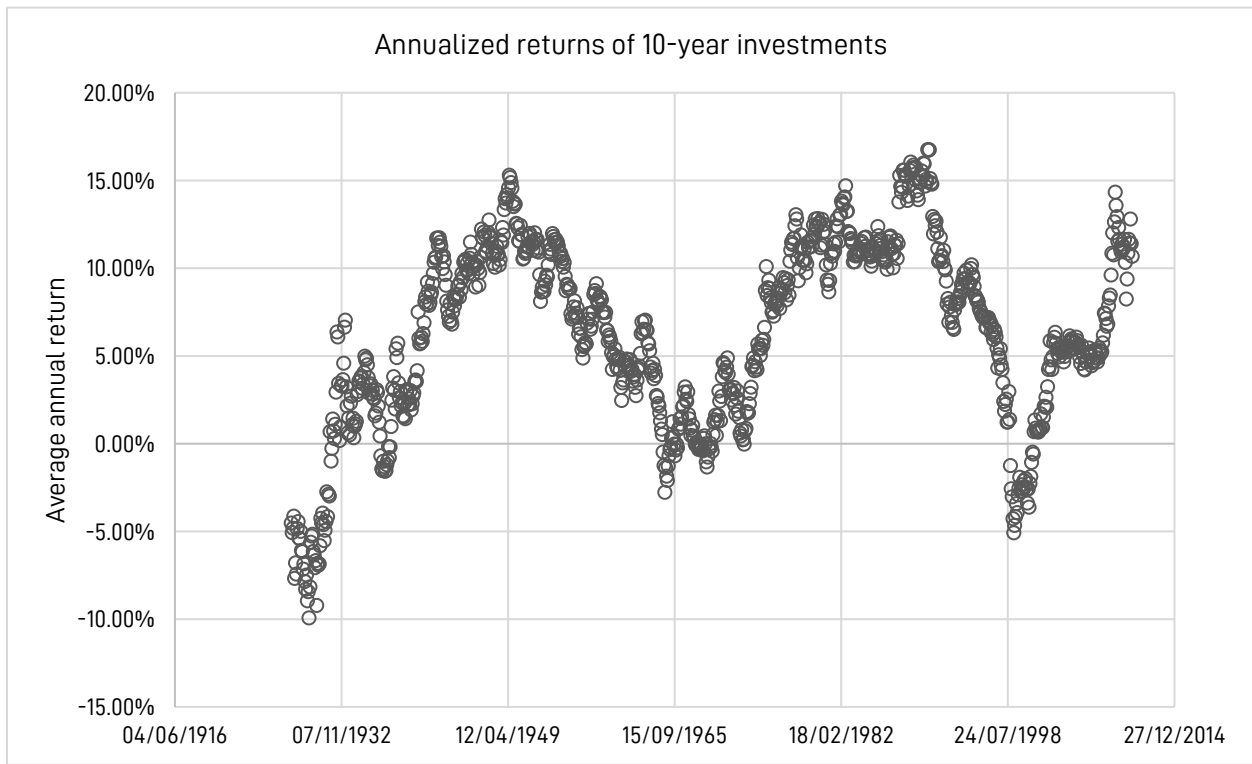

Figure 2 - Annual returns of 10-Year investments in the S&P 500 index - Data from - Data from finance.yahoo.com, 07.11.2020

Figure 2 shows the average annual returns of 996, 10-year investments in the S&P 500. The first investment starts in December 1927 whether the last one starts in November 2010. These investments only account for the price change, therefore only show the capital gain but do not consider dividends. The returns have been calculated with this formula:

$$(Selling\ price\ /\ Buying\ price)^{\frac{1}{y}} - 1 \qquad\qquad (1)$$

Where "y" is the duration of the investment. In case of 10-year investments, "y" is equal to 10.

It is important to notice how this formula gives a return which is meant to be used for an exponential growth of our invested capital. This is the usual growth that we see in all investments unless we take profits before the end of the investment period.
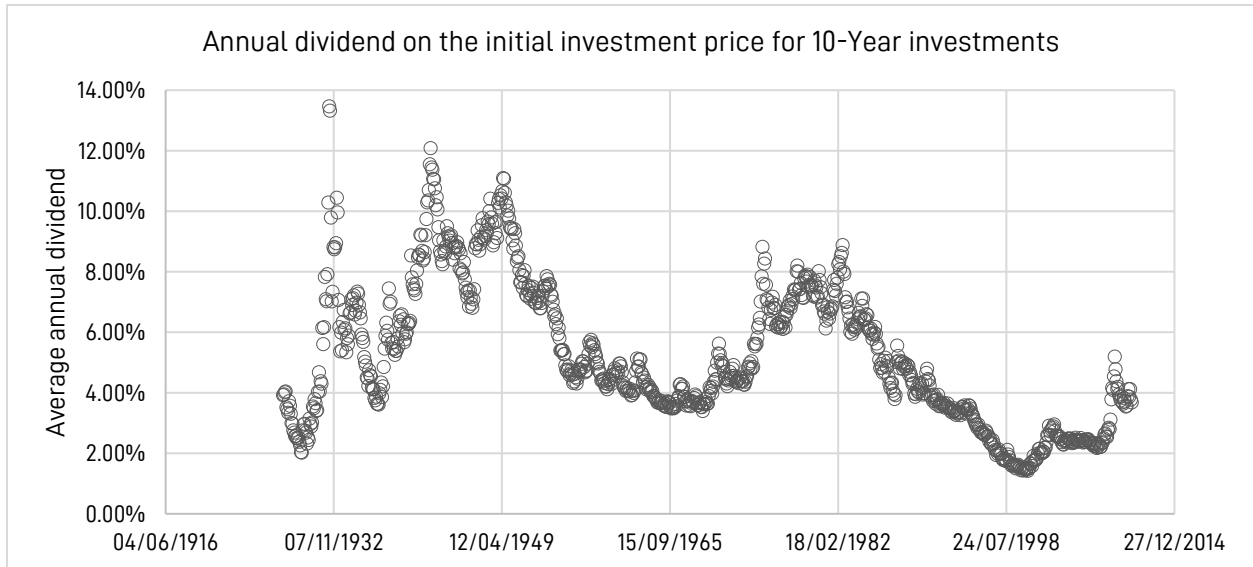
Figure 3 - Average annual dividend in respect to the invested capital for 10-Year investments - Data from quandl.com, 07.11.2020

Figure 3 shows the average annual dividend yield in respect to the invested capital of 10-year investments in the S&P 500. To calculate the dividend yield, this formula has been used:

$$(Sum\ of\ all\ received\ dividends\ in\ \$\ /\ Buying\ price)/y \qquad (2)$$

Where "y" is the duration of the investment. In case of 10-year investments, "y" is equal to 10.

It is important to notice how this is a linear increase of the profits given by the dividends, and not an exponential one. This means that it is not possible to simply add the average annual return given by the price change and the average annual return given by the dividend to find a total average annual return on the investment. To find the dollar profit at any given time during the investment period, this formula should be used:

$$I.\,inv\ \cdot((1 + price\ return)^t + dividend\ return \cdot t) - I.\,inv \qquad (3)$$

Where "t" is the amount of years since the start of the investment and "$I.Inv$" is the initial investment.

We can simplify the calculations and find an annualized total return which includes the dividends as well; this is useful to talk more easily about the overall return of the index, even though it is going to be a simplification of the true performance. To find this annualized return to be used in an exponential growth of our invested capital, the following formula has been used:

$$T.\,R. = ((Selling\ price + Sum\ of\ all\ received\ dividends\ in\ \$)/\ Buying\ price)^{\frac{1}{y}} - 1 \qquad (4)$$

Where "y" is the duration of the investment. In case of 10-year investments, "y" is equal to 10.

It is important to notice how this formula gives an annualized return which should not be used to calculate the profit at any given time during the investment period, rather only the profit at the end of the investment period (10 years for figure 2 and 3). To do this we can use this formula:

$$Initial\ investment \cdot ((1 + T.\,R.)^y) \qquad (5)$$

Where "y" is the duration of the investment. In case of 10-year investments, "y" is equal to 10.
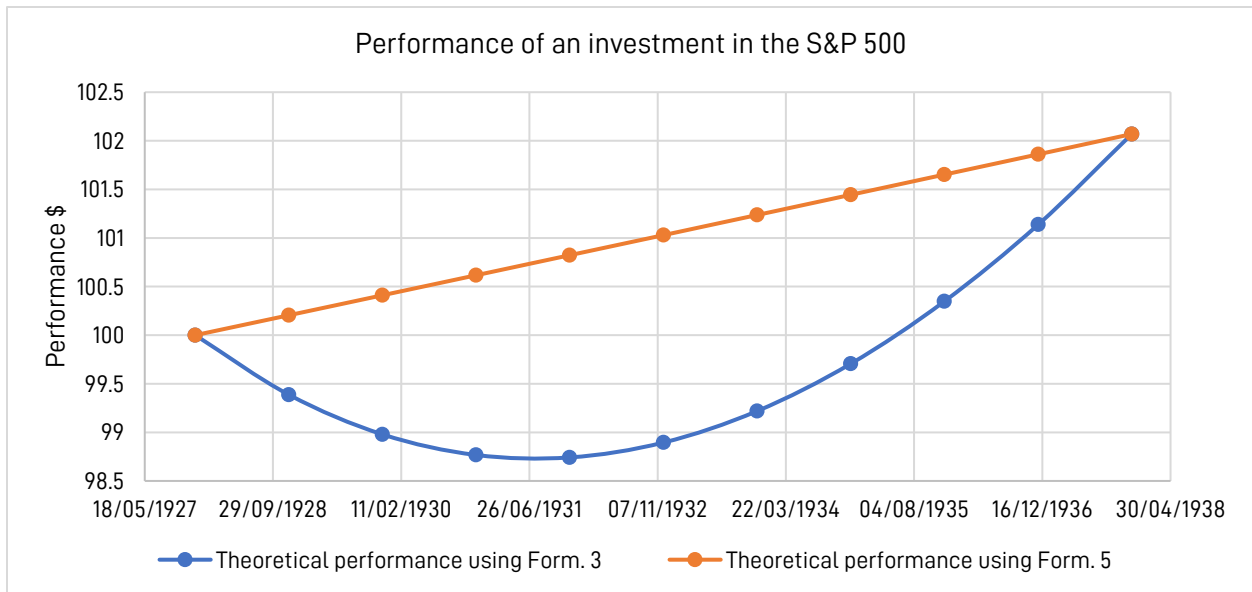
Figure 4 - Theoretical performance of a $100, 10-year investment, in the S&P500 started in 01/12/1927, using formula 3 and 5

Figure 4 shows the difference between using formula no. 3 and no. 4, in particular, figure 4 shows the theoretical[1] performance of the first investment started in December 1927 and ended in November 1938. The blue line shows the true theoretical performance of the investment, whether the orange line is only useful to find the performance at the end of the investment period (10 years in the case of figure 4). This is important to understand as it is easier to talk about only one total return (given by formula 4) even though this means we should not calculate a theoretical profit during the investment period, rather only the profit at the end of it.
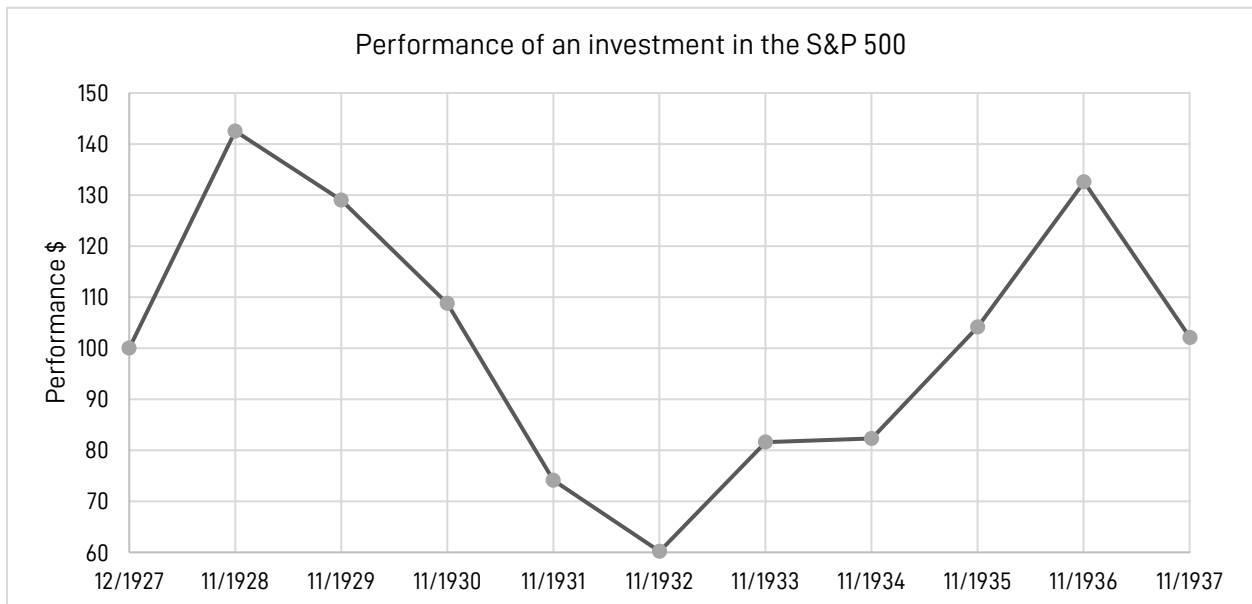

Figure 5 - True performance of a $100 10-year investment in the S&P 500 starting in December 1927, ending in November 1937

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[1] By theoretical we mean that the annualized return has been used to calculate the performance, regardless of the true fluctuations of the index price.
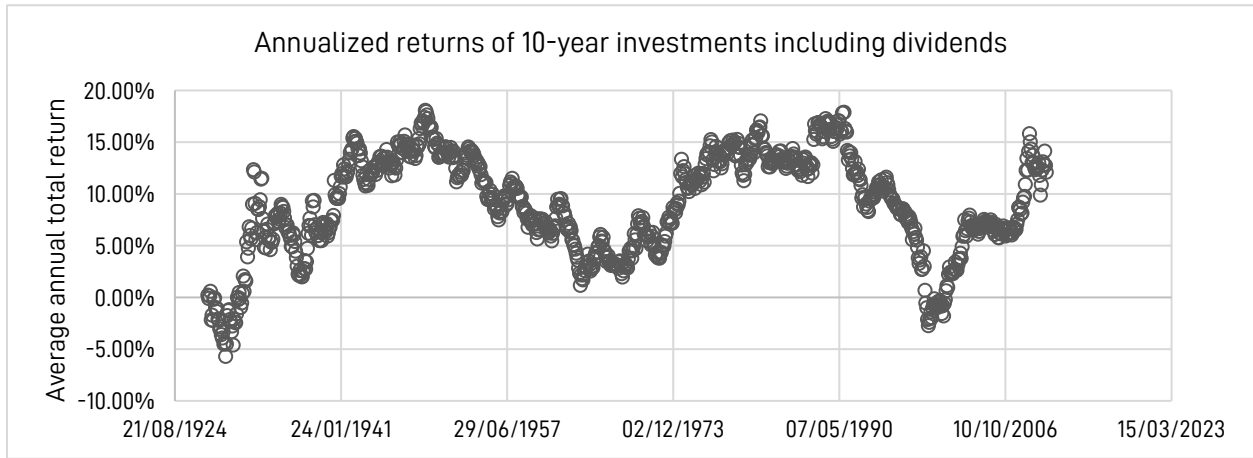
The total returns on investments in the S&P 500

Figure 6 - Annualized returns of 10-year investments in the S&P 500, including dividends, from 01.12.1927 to 01.11.2010 - Data from finance.yahoo.com and quandl.com, 07.11.2020
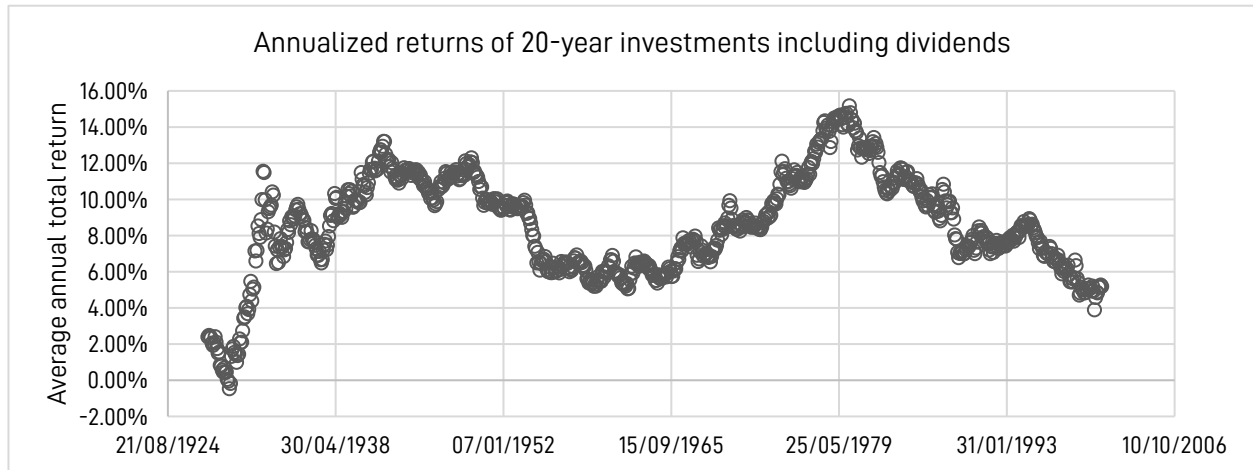

Figure 7 - Annualized returns of 20-year investments in the S&P 500, including dividends, from 01.12.1927 to 01.11.2000 - Data from finance.yahoo.com and quandl.com, 07.11.2020
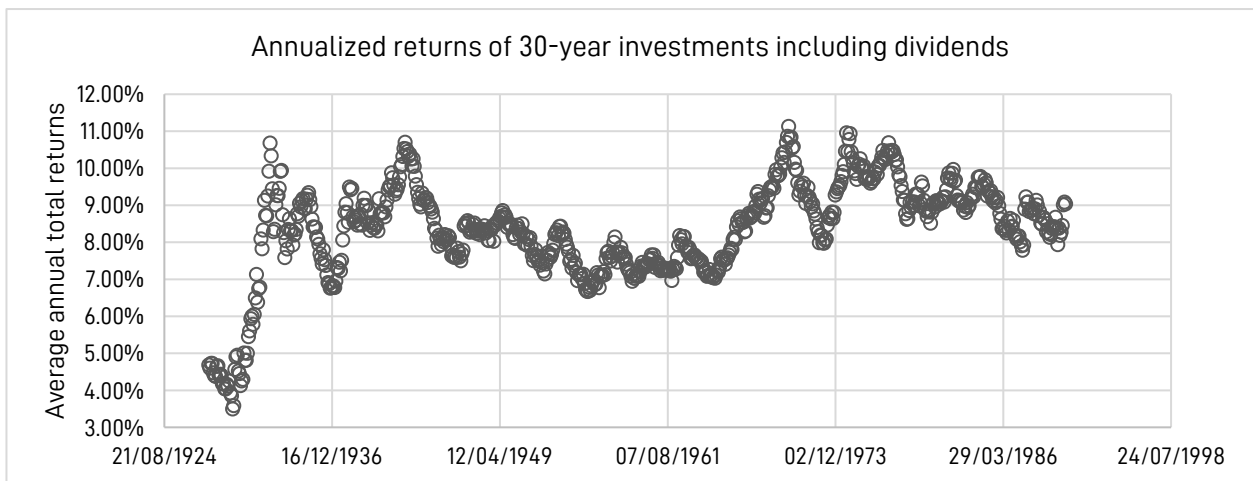

Figure 8 - Annualized returns of 30-year investments in the S&P 500, including dividends, from 01.12.1927 to 01.11.1990 - Data from finance.yahoo.com and quandl.com, 07.11.2020

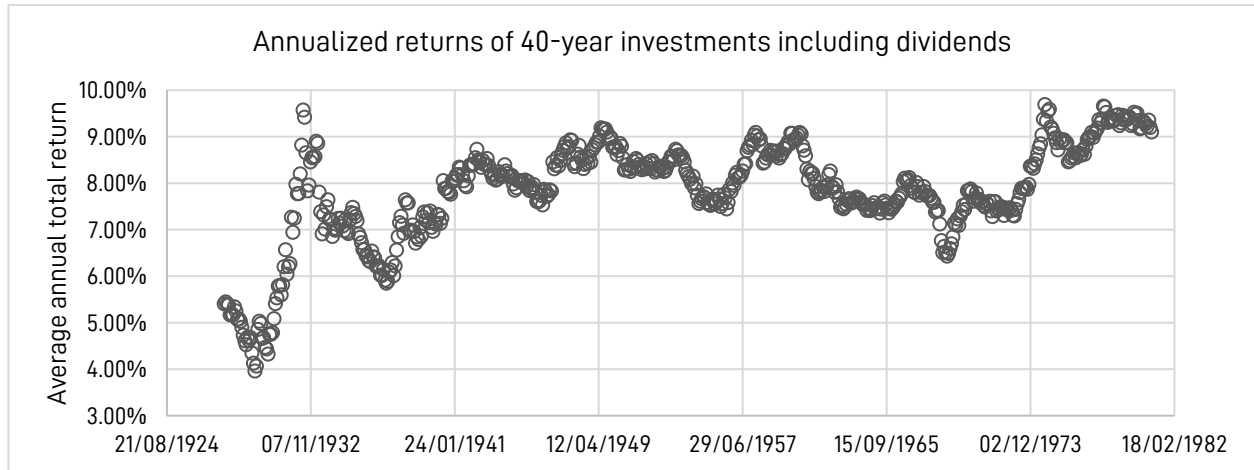**Annualized returns of 40-year investments including dividends**

Figure 9 - Annualized returns of 40-year investments in the S&P 500, including dividends, from 01.12.1927 to 01.11.1980 - Data from finance.yahoo.com and quandl.com, 07.11.2020

Figures 6, 7, 8 and 9 show the returns of 10-year, 20-year, 30-year and 40-year investments starting each month of the year, including dividends, respectively. There are in total 3'264 simulated investments.

We can see that the distribution of returns changes as the starting month of the investment changes. It is particularly interesting to notice how there is no clear trend in returns for any type of investment. In other words, we do not see the returns increasing nor decreasing as we start the investment later in the years, we rather see a horizontal trend suggesting that the average returns of the S&P 500 do not increase or decrease as we approach "modern days". This statement is a statement that often is heard by many investors: *The S&P 500 grew too much, how can it sustain further growth at the same rates?* Well these historical charts suggest that previous growth of the S&P 500 does not necessarily impact future returns.

Another interesting, even though predictable, aspect we notice, is that the more we increase the investment period (30-year and 40-year investments for example), the less volatile returns are throughout the years, suggesting that the longer we invest our money in the S&P 500 the more predictable the returns are.

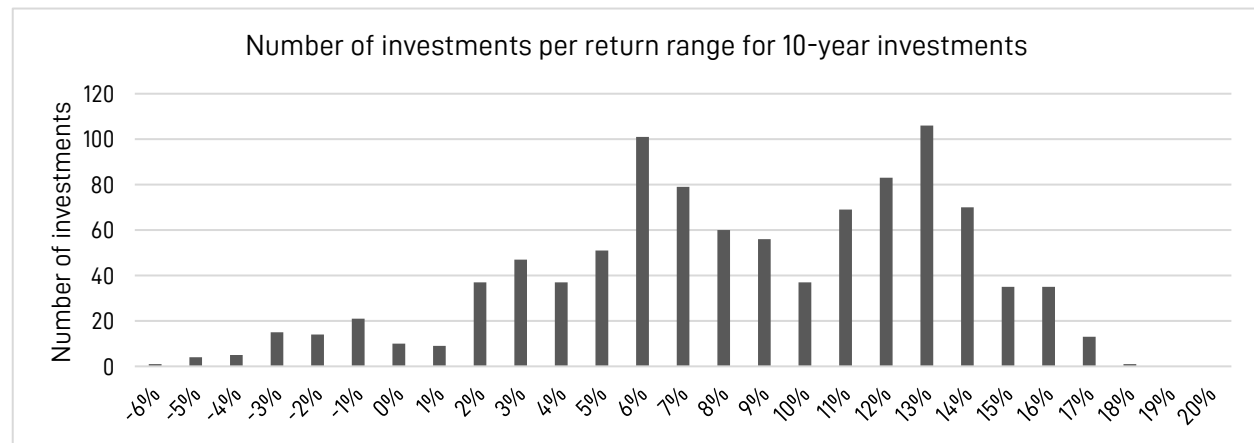**Number of investments per return range for 10-year investments**

Figure 10 - Number of investments per range of return for 10-year investments; 0% represents the range from 0% to 1% - Data from finance.yahoo.com and quandl.com, 07.11.2020

Figure 11 - Number of investments per range of return for 20-year investments; 0% represents the range from 0% to 1% - Data from finance.yahoo.com and quandl.com, 07.11.2020
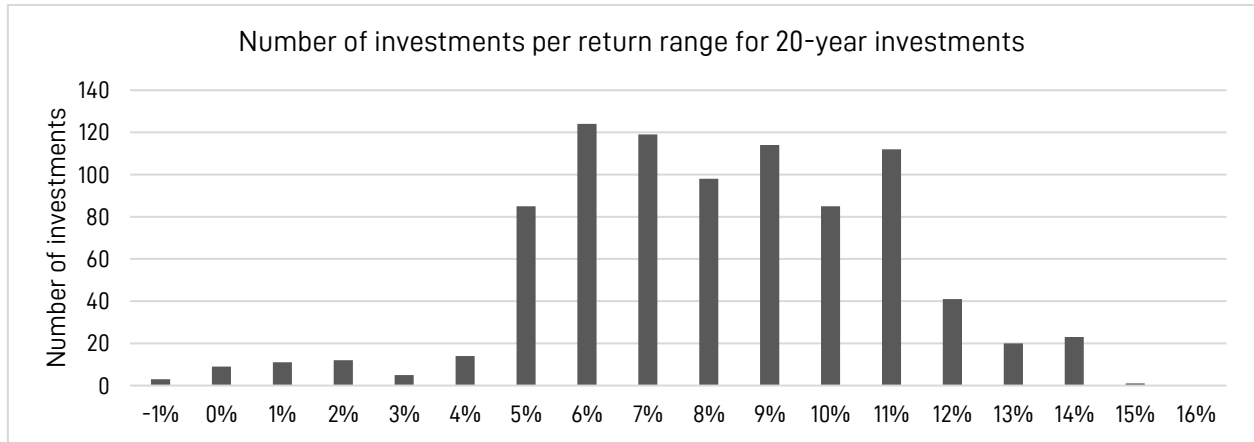

Figure 12 - Number of investments per range of return for 30-year investments; 0% represents the range from 0% to 1% - Data from finance.yahoo.com and quandl.com, 07.11.2020
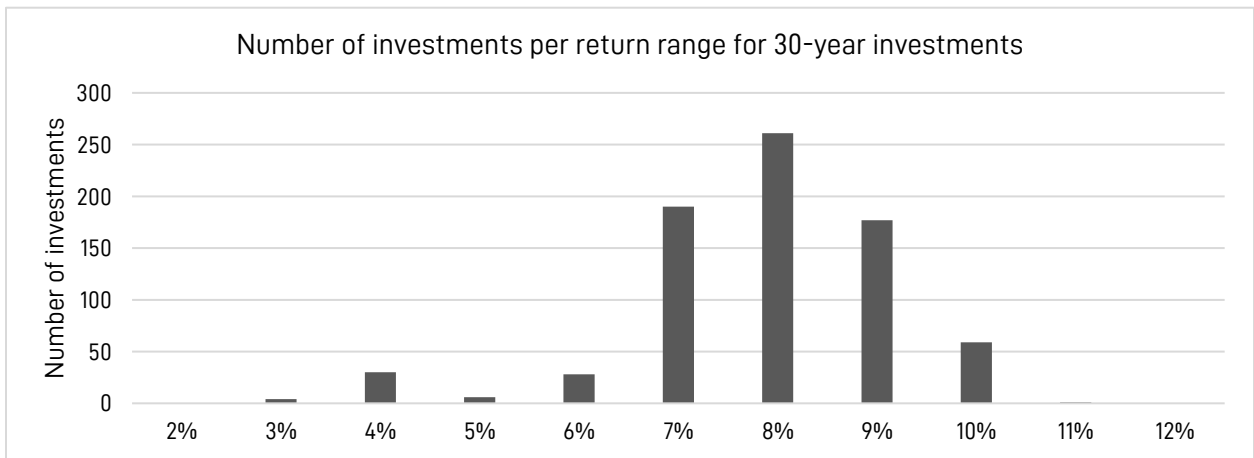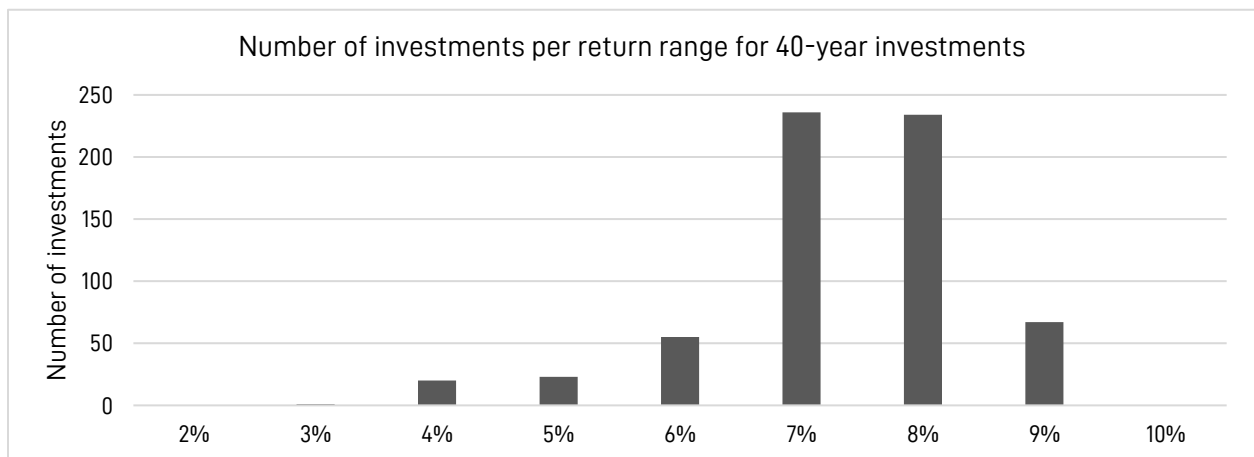

Figure 13 - Number of investments per range of return for 40-year investments; 0% represents the range from 0% to 1% - Data from finance.yahoo.com and quandl.com, 07.11.2020

Figures 10, 11, 12 and 13 show the distribution of investment returns per range of return. We can once again see that the longer the investment period is, the narrower the range of returns and the more returns fall into less return ranges. To understand this even better we can calculate the ranges of returns that cover more than 90% of all investments, for all 4 time-horizons, around the average return:

Table 1 - Significant investments and ranges of returns where "Avg." is the average return, "Tot. sim." is the total number of simulated investments, "Sig. sim." is the number of significant simulated investments, "% of sig. sim." is the percentage of significant simulated investments in respect to the total number of simulated investments and "Range" is the return range that covers the significant simulated investments annualized returns.

Investment period	Avg.	Tot. sim.	Sig. sim.	% of sig. sim.	Range
10-year investments:	8.99%	996	903	91%	2% to 17%
20-year investments:	8.60%	876	798	91%	5% to 14%
30-year investments:	8.33%	756	715	95%	6% to 11%
40-year investments:	7.83%	636	615	97%	5% to 10%

With table 1 it is even clearer how predictable the return of long-term investments is: For 10-year investments we have a relatively wide range that goes from 2% to 17% annualized returns, whether for 40-year investments this range is 5% to 10% annualized returns.

Conclusion

In conclusion we can see that by looking at past performances, it does not appear that the annual returns of the S&P 500 decrease or increase with time, and this could probably be expected also in the future. The returns of the S&P 500 seem to be dependent only on the price when starting the investment (obviously), but the longer we keep our investment, the less relevant the starting time (so the starting price) becomes. This is shown by how small the range of returns is for long-term investments (30-year and 40-year investments in particular) relatively to short-term investments (10-year and 20-year investments).

We can therefore state that long-term investments give a more predictable return for the future, which ranges from 6% to 11% for 30-year investments, and 5% to 10% for 40-year investments.

It is also interesting to see how, regardless of the length of the investment period, the average annual return varies between 7.83% and 8.99%. So, even for smaller investment periods, the average return is still relatively high.

It is important to notice how this analysis has been done with the price return version of the S&P 500 plus the dividends, and not the total return version of the index. This means that for a total return version, the ranges of returns would be greater, as the reinvestment of the dividends increases the total profit. Unfortunately, it has not been possible to find good quality historical data for the total return version of the S&P 500 index.