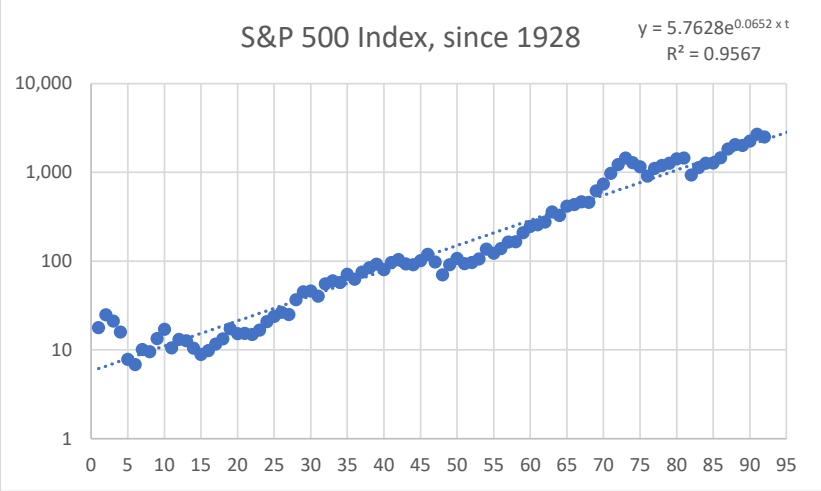
This is equivalent to a combined average annual growth rate of 7.8% (approx. 5.7% + 2.0%)

3.3 Exponential nature of US asset indices of interest

Using the US S&P 500 Index, as an example, its long-term exponential nature can be seen from its long-term time series, over the period 1928 to 2019 [4]. A semi-log plot for the entire time series is given in Figure 3.

Figure 3: The growth in the US S&P 500 Index for the period 1928 to 2019 (years 0 to 92) (semi-log plot)

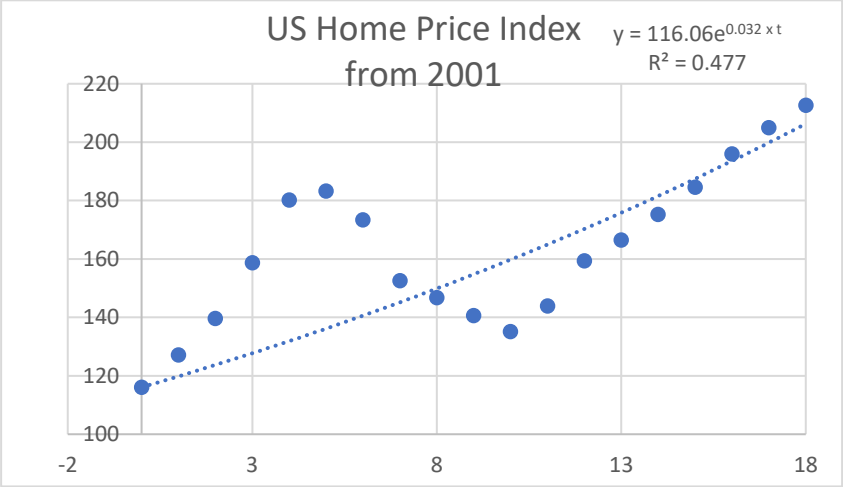


Applying an exponential growth function over the time period, provides a rate constant, $\lambda = 0.0652$. This corresponds to an average annual % increase in the S&P 500 Index of approx. 6.7% over this long time period. The coefficient of determination (R^2) for the exponential characterization of the S&P 500 Index data is approximately 96%.

3.4 Information Entropy of the US National Home Price Index (2001 to 2019)

Using 2001 as the reference year (year = 0), the growth in the US National Home Price Index for the period 2001 to 2019 (years 0 to 18) [5] is given in Figure 4.

Figure 4: The growth in the US National Home Price Index for the period 2001 to 2019 (years 0 to 18)



As can been seen, the US National Home Price Index was greatly impacted by the financial crisis of 2007-2008. Notwithstanding, applying an exponential growth function over the period, provides a rate constant, λ = 0.0320. This corresponds to an average annual % increase in the US National Home Price Index of 3.3% over this time period. The coefficient of determination (R^2) for the exponential characterization of the US National Home Price Index data is approximately 48%, reflecting the considerable decline in prices following the financial crisis.

The information entropy of the US National Home Price Index for this time period is given by the equation:

$$Info\ Ent\ (US\ Home\ Price\ index) = 0.0320\ x\ t$$

Notwithstanding the financial crisis of 2007-2008, this annual rate of increase in the US National Home Price Index over this time period is considerably greater than the corresponding growth in US GDP. However, it can be described as follow:

$$Info\ Ent\ (US\ Home\ Price\ index) =$$

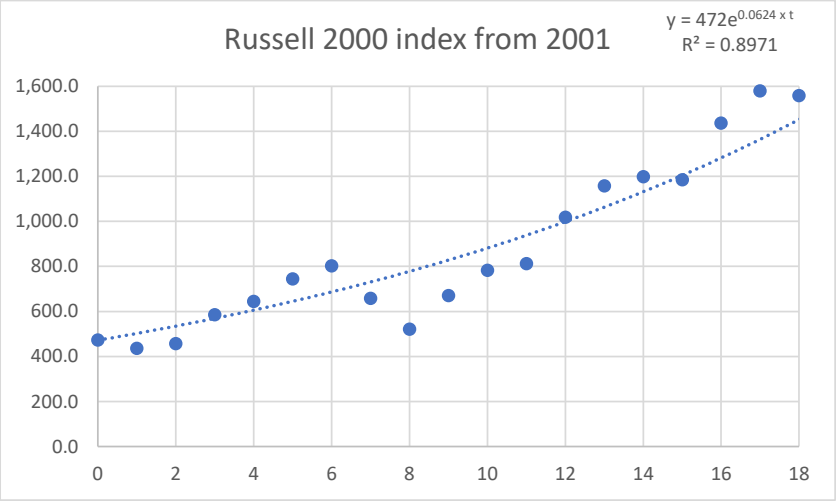
$$Info\ Ent\ (US\ Broad\ Money\ Supply) - Info\ Ent\ (US\ GDP) - 0.0038 = 0.0320\ x\ t$$

This means that the US National Home Price Index over this time period had approx. 89% of the average annual rate of growth of the US Broad Money Supply minus the average annual rate of growth of US GDP.

3.5 Information Entropy of the US Russell 2000 Index (2001 to 2019)

Using 2001 as the reference year (year = 0), the growth in the US Russell 2000 Index for the period 2001 to 2019 (years 0 to 18) [6] is given in Figure 5.

Figure 5: The growth in the US Russell 2000 Index for the period 2001 to 2019 (years 0 to 18)



As can been seen, the US Russell 2000 Index was significantly impacted by the financial crisis of 2007-2008. Notwithstanding, applying an exponential growth function over the period,