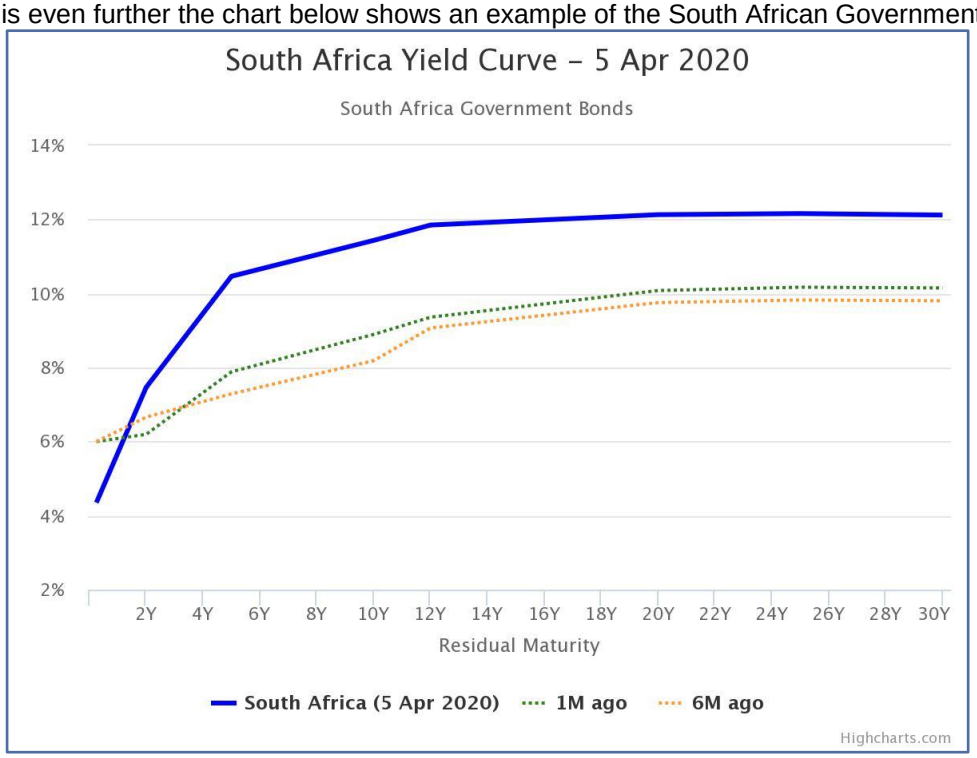
Addendum: Understanding the yield curve and the concept of duration

What is a yield curve?
Investments in bonds with different timeframes provide different levels of return/yield (similar to what we commonly think of as an interest rate). Government bond prices move on a daily basis as they are traded amongst various investors and as a result, their yields move around constantly. We can observe the market implied yields on government debt (in the case of SA we use the full spectrum of South African government bonds currently in circulation to do this). From this we can derive a "yield curve" that shows the yields for all the various maturities/investment time horizons.

To help us clarify this even further the chart below shows an example of the South African Government Bond yield curve.



Now this is where things get interesting. Each of the rates on the yield curve can move independently as we move through time. So with each passing day, month and year, the yield curve changes shape, and each point on the yield curve can move fairly independently. For example, at the same time as the one-year rate goes upward, a longer-term rate like the 20 year rate can move downward and vice versa. Or they can move in a parallel fashion, but at different rates at different points on the yield curve.

The best way to really understand this is to see it. So I am going to ask you to follow a link to see an animated time lapse version of a yield curve on YouTube.

https://www.youtube.com/watch?v=WM-NGndzBFo

In the animated YouTube example, we see historical movements in the US yield curve. It shows how the different rates can move independently of each other and how this causes the yield curve to change shape. One can see how sometimes short-term rates have been lower than long-term ones - what we call an upward sloping yield curve. Sometimes short-term rates are similar to long-term ones - called a flat/flattening yield curve. And sometimes short-term rates are higher than long-term ones - which is called an inverted yield curve. The reasons for the changing shape of the yield curve are numerous

and complex, and that discussion is beyond the scope of this document. Suffice it to say that the short-term interest rate can be very different from medium and long-term rates.

Duration

When we invest in bonds, we get interest payments on the bonds. Duration measures how long it takes for an investor to be repaid the principal he invested in the bond by the bond's cash flows (interest payments).

The longer the time until the principal is eventually repaid by the interest payments, the greater will be the bond price's sensitivity to changes in interest rates. (The higher the duration, the more a bond's price will drop as interest rates rise). This is because the further into the future it is, the greater the compounding effect is of discounting that cash flow at a given interest rate (and therefore if that rate changes, the effect is going to be bigger than over a shorter time period).

Now if we calculated the present value of all the individual annual cash flows one at a time using an interest rate applicable to each (taken from the correct point on the yield curve for each), and then weighted those individual present values by how far into the future they will occur, we would get a weighted average maturity for those cashflows.

Modified duration

There is a closely related concept to the duration described above, and that is called "modified duration". For our purposes, the equality (or near-equality) of the values for these two types of duration can be a useful aid, and so we will consider them equal.

This may sound very confusing, but the important thing to understand is that the concept of modified duration is a way of summarising the sensitivity of a bond's current value/price to changes in prevailing interest rates for different time horizons (remember the yield curve shows us that the interest rate for a 2-year bond is usually different for that of a 10-year bond). Once we have this number (the duration of a bond), it can tell us how the values of a fixed interest rate bond will increase/decrease in response to a change in interest rates. For example, if the modified duration of a bond is 20, then for each 1% change (up/down) in interest rates, the value of the scheme's liabilities will change by 20% (we multiply the interest rate change by the duration).

This concept is useful, because it helps us not only to calculate the duration (interest rate sensitivity) of a single bond, but we can also calculate the duration of a portfolio of bonds. So by looking at the duration of flexible fixed income funds we can see how sensitive they are to changes in interest rates.

When we understand the concepts of the yield curve and duration, which are specifically applicable to fixed interest rate bond investments, we can go on to consider the broader types of investments in which flexible fixed income funds invest.