Explaining what drives stocks prices – 14 years of evidence

July 2022

Summary

Quant Insight extracts the sensitivities of asset prices to various key macro factors covering economic fundamentals, financial conditions and measures of investor risk aversion.

These sensitivities are calculated every day for thousands of stocks using a rigorous yet transparent process employing a 12-month lookback. The output of this process not only measures the sensitivities but also provides a "model confidence" number (or R-squared). This shows the extent to which macro factors explain the variation of the asset price over the previous 12 months Core method explained in this 8 min video.

The advantage of calculating this daily is that it allows the sensitivities to adapt gradually as market relationships change, thereby giving portfolio managers the most up to date information.

As this becomes more widely adopted in the asset management sphere, it is worthwhile running more analysis that demonstrates the validity and stability of these macro sensitivities.

Note that the notion of validity *in this context* really consists of two key parts:

1) **Whether the calculated sensitivities are spurious / co-incidental**
2) **Whether the calculated sensitivities exhibit stability and persistence**

The three sections below shed further theoretical and empirical light on these questions.

Section 1: Stability and effectiveness of Qi macro factor sensitivities

We conducted a simple experiment for each of the S&P500 stocks over the last 14 years. We did this by asking the following question:

If you had Qi macro factor sensitivities for a stock today, and you knew what the macro factors were going to do over the next 1 month, how accurately would you be able to predict the directional move in the price of the stock over the next 1 month? What if you did this every month for 500 stocks over the last 13 years? In other words, if you know today's "macro DNA" of a stock and knew what the macro factors were going to do, how well would you be able to predict directional moves?

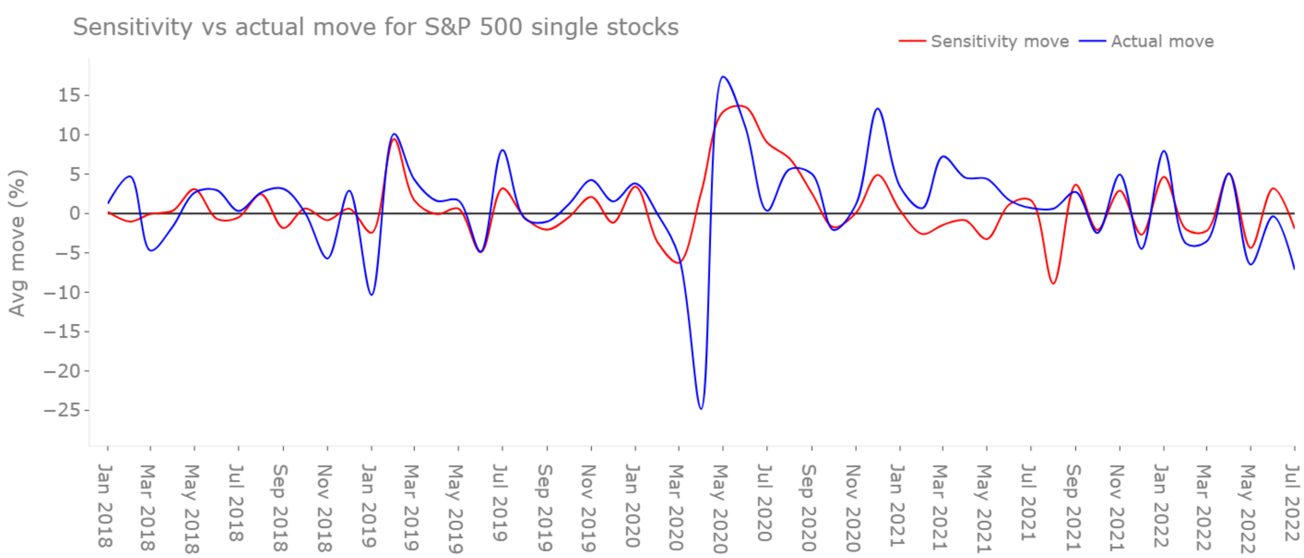
This is quite a stringent test because sensitivities would be several weeks out of date as one neared the forecast horizon of 1 month. Underlying relationships would undoubtedly have shifted. However, if they were fairly stable over the following month then there should be some predictive power.

- We find that even out-of-date sensitivities have over 58% success rate in predicting the direction a stock will take over the next one month.
- The total sample size was 47,600 months
- The average R-squared for all these stocks over this period was 58%
- We further find that this success rate is higher when model confidence (R-squared) is higher and vice versa, which is very much what one would want to see.

We then looked at how accurate the projected moves based on sensitivities were relative to actual moves, focusing on the last 5 years

- As an example that provides an easy way to visualise the result, the chart below shows the average **projected** move in S&P500 stocks (derived using sensitivities) and the average **actual** change in S&P500.

The full study with all detailed results and a data file is available on request. The results can also be replicated using a Qi API key to access all the historical sensitivity and R-squared data since 1st Jan 2009.



Method: Take a constituent of the S&P 500 index (e.g. Apple). Then take Qi macro sensitivity data specific to Apple just for the first day of a month, let's say for the 1st January 2022. This data will consist of circa 25 sensitivities, associated to circa 25 macro drivers, which will have some impact on the price action of Apple stock over time.

Taking one macro factor, such as USD Liquidity, if the Z-score of USD Liquidity moves by 1 standard deviation, then that will result in a price move equal to the sensitivity of Apple to USD Liquidity. This assumes that all other factors' Z-scores have experienced no movement, which, in reality, does not happen.

Considering all the drivers' sensitivities and their Z-score moves, we can calculate a projected Qi Model Value move for this month.

This is of interest is because we have sensitivity data for Apple dating back to 1st January 2009. We can therefore see the actual macro driver Z-score moves for the associated factors across the month of January to the beginning of February, and we can see if the Qi model value move was in the same direction as the actual spot price move for that month. We can then repeat this calculation for every month of data that we have, for all S&P 500 index constituents.

The chart above compares the average projected move over one month ("sensitivity move") with the actual average moves over that one month.

It is worth re-iterating that spot sensitivities will be more accurate than outdated sensitivities from several weeks earlier. There is no reason why one would ever use old/outdated sensitivities in practice. Daily recalculation is now easy given the ample processing power available and this allows sensitivities to gradually adapt to shifting market conditions. There is no advantage in using old data! The purpose of this experiment is simple to show that the sensitivities work even when outdated.

The implication from the above is that there is stability and persistence in the Qi sensitivities.

Section 2: Stress testing the sensitivities

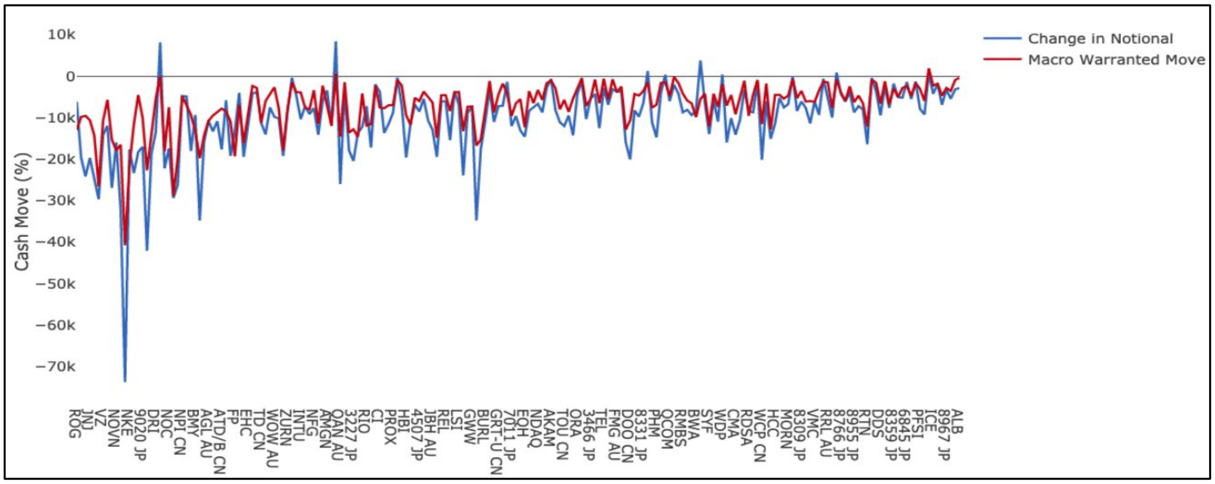
The macro factor framework will be of particular benefit to investors in market environments where macro factors dominate. We demonstrate the accuracy and effectiveness of the macro factor sensitivities during a major macro shock. We picked the most acute macro shock of recent times – the Covid crisis over Jan – April 2020.

We analysed the accuracy of the sensitivity measures using an actual anonymised client portfolio with circa 187 global stocks. **We find that over this intense macro shock the sensitivity data in Jan 2020 were able to explain circa 70% of the portfolio movement over the next 2 months.**

We used the same method as in Section 2, but this time instead of looking at a 1 month horizon for many stocks, we have focused purely on a 2 month period between 23rd January and 20th March 2022 using an actual client portfolio during that time.

The key finding is that Qi sensitivities exhibit stability over a full 2 month forward period in one of the largest macro shocks and most volatile periods seen. A noteworthy result.

The chart below compares the actual move in the value of 187 stocks between the two dates (blue) and the predicted move based on values on 23rd January 2020 combined with the factor moves through to 20th March 2020.



The full list of stocks as well as all the data required to replicate this analysis is available via API.

Section 3: Valid and non-spurious macro factor sensitivities

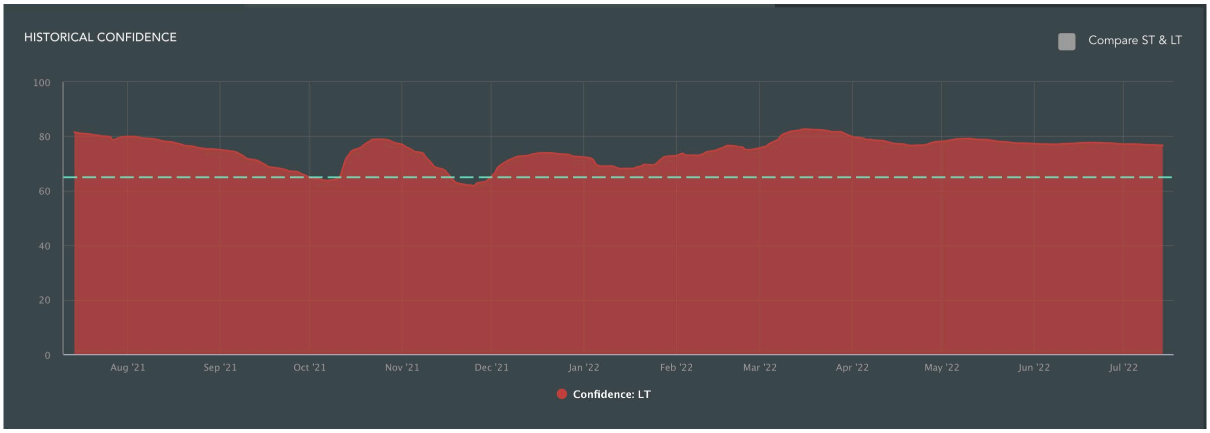
A key requirement is that calculated sensitivities accurately reflect the actual deep underlying relationships between macro variables and asset prices. When working with many time series in a model there is a risk of picking up spurious or co-incidental relationships. How can we tell if Qi's core Principal Component Regression is producing spuriously high R-squared statistics? R-squared is a measure of "fit". It is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by the independent variables.

Like any statistic, R-squared has a distribution. If one were to take data sets that one knew in advance were fake and spurious, and one ran many regressions, there would almost certainly be some instances of high R-squared. This would be an example of a spuriously high and misleading measure of fit.

The key point here is that using fake data and looking at R-squared as a function of time will show that the R-squared values are normally distributed with fake/random data. The R-squared history will move around between 0 and 100% and will look like a random walk with no discernible structure.

However, Qi's R-squared histories exhibit persistence and look very different to the noisy R-squareds generated by fake data. Qi R-squareds are highly inconsistent with those drawn from fake/random data.

A simple example below shows the Qi DAX model R-squared history over the last 12 months. **The key "signature" of non-spurious R-squared is that it does not look like it is drawn from a random distribution between 0 and 100%.** QI's R-squareds are persistent and "sticky". This signature is seen in Qi historical R-squareds across the board.



(Further technical reading on this topic is set out at the end of this paper)

This R-squared "signature" is the key evidence that Qi's model, and therefore the sensitivities drawn from it, are extracting valid relationships that are not spurious in nature.

Further reading

Cramer, J. S., 1987. Mean and variance of R2 in small and moderate samples. Journal of Econometrics, 35, 253-266.

Carrodus, M. L. and D. E. A. Giles, 1992. The exact distribution of R2 when the regression disturbances are autocorrelated. Economics Letters, 38, 375-380.