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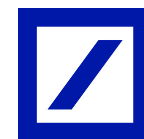

Global

Cross-Discipline
Thematic Research

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Yield Curve 101

Jim Reid
Strategist
+44-20-754-72943

Craig Nicol
Macro Strategist
+44-20-754-57601

Throughout my career my favourite lead indicator of the cycle has been the yield curve (YC). In this note we wanted to explore how the YC became established as a predictor of the cycle, what it's telling us now, what the person who discovered its great track record in 1986 has been observing of late, what our economists are currently thinking, what the impact has been on asset prices historically, and why it always spurs talk of "this time is different" including where eminent market participants got it wrong in previous cycles.

Why the concern?

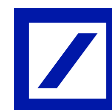
Early last week the US YC flattened dramatically and 5 year treasury yields fell through both 2 and 3 year equivalents for the first time since 2007. Meanwhile, for a brief period the difference between 2 year and 10 year yields also fell below 10bps for the first time since June 2007 – perilously close to inverting. None of the last nine US recessions have occurred without 2y10y or 3y5y inverting – albeit with a lag that we'll discuss below. As such markets are correct to be worried.

Who discovered the link?

The person that lays claim to establishing the link between the US curve and the business cycle was Campbell Harvey, a professor of finance at Duke University's Fuqua School of Business. He laid out his thesis in 1986 and it was published in the Journal of Financial Economics in 1988. That said there is evidence that work by Reuben Kessel, a professor of economics at the University of Chicago's Graduate School of business, predates work by Harvey. In 1965 Kessel published a working paper for the NBER on "The cyclical behavior of the term structure of interest rates". Kessel's theory was similar to a number of other economists insofar as he saw long-term rates as driven by expectations of future short term rates plus a term premium.

The Harvey thesis does seems to be the one that started to elevate the status of the YC as a lead indicator though and since then we've only seen three recessions where the theory has been known about and this awareness has grown over time. It's fair to say that in this cycle there is more focus than in any of the previous three. As such we wonder whether this could be self-fulfilling and bring on a recession quicker than in previous cycles.

DISCLOSURES AND ANALYST CERTIFICATIONS ARE LOCATED IN APPENDIX 1. MCI (P) 091/04/2018 .



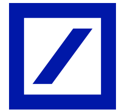
There could be parallels today if the Fed responds dovishly to the recent wobbles in markets and recent softness in inflation. This could delay a slowdown at the expense of exacerbating pressures in the labour market and generating higher inflation further down the line. So food for thought.

What our US economists are saying?

Our US economists have argued against assuming a curve inversion will lead to a US recession this time around, at least not imminently. Indeed they argue that their suite of recession probability models based on the yield curve and other measures of financial conditions suggest that recession risks remain quite low over the next year. In figure 17 of the attached report they present their stable of recession probability models based on the yield curve. These four different probit models are based on: (1) the traditional 2y10y slope, (2) the 3m10y slope which has been advocated by some Fed research, (3) the spread between the 18-month forward 3-month Treasury yield and the spot 3-month Treasury yield (another variant espoused in Fed staff research), and (4) their principal component analysis (PCA) of the spot yield curve.

They write that as has been the case in recent months, traditional yield curve measures, such as the 2y10y slope, are overestimating recession risks over the next year. Their PCA approach, which summarises nearly all of the information embedded in the spot yield curve, continues to point to recession risks over the next year not far from their unconditional expectations (15-20%). Indeed their PCA approach (link here) is an important concept as it in theory circumvents the need to focus on a particular spread metric (which in itself is subjective) since it distils virtually all the information on the spot yield curve. As the team note, a PCA extracts unobservable factors that explain the maximum percentage of variation of the variables in a dataset, while imposing that each of the factors is uncorrelated with each other. In other words, the first factor is an unobservable variable that explains the maximum percentage of the variance in the dataset while being uncorrelated with the remaining factors. The second factor explains the second highest percentage of the variance in the observable variables while being uncorrelated with all other factors, including the first factor, and so on. Significantly, the team find that their analysis indicates that a recession probability model based only on a few factors from a PCA outperforms traditional recession risk measures such as the 2y10y yield curve slope and a measure of the Fed's policy stance.

That being said, the team do acknowledge that beyond next year, recession risks do begin to rise. To make this assessment they use their more comprehensive recession probability model which includes: (1) the first three factors from a yield curve PCA, (2) the Fed's policy stance (real fed funds rate minus neutral as measured by Holston, Laubach and Williams (2016)), (3) excess corporate bond risk premium, and (4) the Chicago Fed's adjusted national FCI. Recession risks over the next twelve months are very low, less than 5%, according to this more comprehensive view from financial conditions. Beyond the next year, the current constellation of financial conditions suggest that recession risks will be on the rise according to the team. This model suggests there is 25% chance of a recession at some point over the next two years. This is near the highest levels since the crisis. Over the next three years, there is nearly an 80% chance of a recession according to this model. In short, the team agree that recession risks should rise



more meaningfully beginning in 2020, but a recession is not part of their baseline expectation.

So we wouldn't disagree with our economists that the recession risk in the US over the next 12 months is low. Their models do indicate that this risk rises quite sharply thereafter though. A recession is not embedded into their forecasts over this horizon as they use other overrides to suggest the US expansion can last for several years. See their 2019 (and beyond) outlook in the link in the first paragraph of this section.

What has been the impact on asset prices historically?

Figure 4 and Figure 6 look at price moves for the S&P 500 and US BBB spread moves respectively from the point that 2y10y inverts and the start of the next recession. We also show the moves incrementally out to two years from inversion to see the profile.

Figure 4: Analysis of S&P 500 Returns Following an Inversion

				Return x Months After Inversion:					
Recession Start Date	First Inversion	Difference (Months)	Inversion to Recession	3 Months	6 Months	9 Months	12 Months	18 Months	24 Months
01/09/1957	30/04/1956	16	-7%	1%	-4%	-7%	-5%	-15%	-10%
01/05/1960	31/08/1959	8	-9%	-2%	-6%	-6%	-4%	6%	14%
01/01/1970	31/12/1965	48	0%	-3%	-8%	-17%	-13%	-2%	4%
01/12/1973	28/02/1973	9	-14%	-3%	-8%	-13%	-14%	-37%	-27%
01/02/1980	17/08/1978	17	10%	-10%	-6%	-5%	3%	10%	20%
01/08/1981	11/09/1980	10	4%	1%	3%	6%	-3%	-13%	-4%
01/08/1990	14/12/1988	19	29%	7%	18%	25%	27%	32%	19%
01/04/2001	26/05/1998	34	6%	-1%	8%	13%	19%	29%	26%
01/01/2008	27/12/2005	24	17%	4%	-1%	6%	14%	20%	17%
		Average	4%	-1%	0%	0%	3%	3%	7%
		Median	4%	-1%	-4%	-5%	-3%	6%	14%
		Pre 1980s Average	-7%	-2%	-7%	-11%	-9%	-12%	-5%
		Post1980s Average	13%	0%	4%	9%	12%	16%	16%

Source:Deutsche Bank, GFD, Bloomberg Finance LP, Haver

For the S&P 500 the analysis is slightly complicated by the fact that for the period from the 1957 recession (the first in our sample) to those seen around the early 1980s, we saw a bear market for valuations (Figure 5). In contrast the post-1980 period has generally seen a structural bull market. As such, each of the post 1981 recessions have seen the S&P 500 climb between inversion and recession. So if you think we're still in this structural bull market then positive performance after we invert is not inconsistent with recent pre-recessionary periods. For the five cycles prior to 1981 the inversion signaled bad price performance ahead though. The table shows each cycle for references. Given the polar split pre and post-1980 the averages could be seen as a little meaningless.

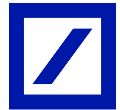
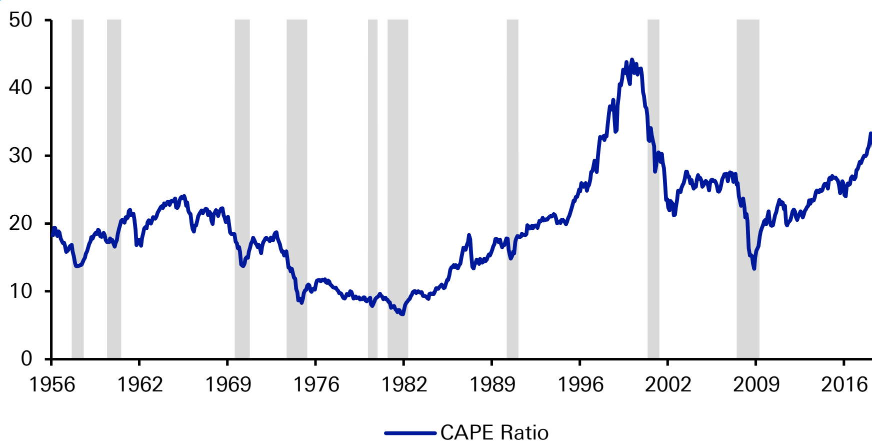


Figure 5: Cyclically Adjusted Price Earnings (CAPE) Ratio



Source: Deutsche Bank, http://www.econ.yale.edu/~shiller/data.htm

For BBBs, there is little ambiguity in the results. Spreads have always widened from inversion to recession with very few periods within this seeing any temporary respite. This is perhaps because spreads are far more cyclical than equity valuations that tend to move in multi-decade structural cycles. BBB behaviour might also be much more linked to the obvious and observable opportunity costs. A long dated BBB yield is likely to look less attractive as the curve flattens. Short-dated yields will offer much more attractive relative value than when the curve is steep.

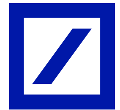
Figure 6: Analysis of BBB Spread Moves (US) Following an Inversion

				Spread Move x Months After Inversion:					
Recession Start Date	First Inversion	Difference (Months)	Inversion to Recession	3 Months	6 Months	9 Months	12 Months	18 Months	24 Months
01/09/1957	30/04/1956	16	30	26	19	28	46	51	129
01/05/1960	31/08/1959	8	34	7	19	27	62	63	41
01/01/1970	31/12/1965	48	59	4	36	50	57	72	56
01/12/1973	28/02/1973	9	36	9	-23	28	24	34	192
01/02/1980	17/08/1978	17	87	-3	24	29	41	87	146
01/08/1981	11/09/1980	10	43	12	42	20	2	81	139
01/08/1990	14/12/1988	19	25	14	17	30	45	22	62
01/04/2001	26/05/1998	34	111	6	75	5	14	31	104
01/01/2008	27/12/2005	24	67	-1	8	7	-1	-4	69
		Average	55	8	24	25	32	49	104
		Median	43	7	19	28	41	51	104
		Pre 1980s Average	40	11	13	33	47	55	105
		Post1980s Average	67	6	33	18	20	44	104

Source: Deutsche Bank, GFD, Bloomberg Finance LP, Haver

Conclusion

The good news is that our favoured indicator (2y10y) hasn't yet inverted and that its lead time from inversion to recession is on average nearly 18 months. The earliest recession after inversion in the nine cycles analysed was 8 months. So in the near-term this suggests the economy is in no immediate danger. It's also possible that Goodhart's law might apply as the YC has never captured as much interest as a lead indicator as it does currently. However this increasing awareness



could actually alternatively be self-fulfilling and accelerate the loss of animal spirts in the economy.

Whichever way you look at it, the risks build over time the longer the curve stays flat or inverts. Our economists remain hopeful that this cycle will last several more years. However their comprehensive recession probability model (with more than just the YC) has the risks increasing from only 5% over the next 12 months to 25% over the next two years and 80% over three years.

Overall whether you look at the US economy or asset prices, its hard to be optimistic over the medium-term if you believe the YC will soon invert. Thus risks would seem to be on the downside.

Appendix: What has been said in the past

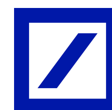
Given the link between the YC and recessions was only discovered in 1986 we don't have many cycles where the link was known. So we thought it would be interesting to review these cycles and see what eminent market participants made of inversions and whether they would lead to a recession. As you'll see below its been perilous to doubt the impact of the YC but "this time is different" arguments commonly surface. Similar language and sentiment has been used in this cycle as well which adds to the intrigue.

As we'll see below former Fed Chair Bernanke dismissed the flat yield curve as a signal in 2006 and again earlier in July 2018 suggested that “the inversion of the yield curve has been a good sign of economic downturns but this time it may not”. Bernanke suggested that normal market signals have been distorted by “regulatory changes and quantitative easing in other jurisdictions”. These are similar ‘this time is different’ remarks to those made in March 2006. See the text below for his rationale.

2008 Recession
Bernanke (March 2006): The Yield Curve and Monetary Policy

"I would not interpret the currently very flat yield curve as indicating a significant economic slowdown to come, for several reasons. First, in previous episodes when an inverted yield curve was followed by recession, the level of interest rates was quite high, consistent with considerable financial restraint. This time, both short- and long-term interest rates--in nominal and real terms--are relatively low by historical standards. Second, as I have already discussed, to the extent that the flattening or inversion of the yield curve is the result of a smaller term premium, the implications for future economic activity are positive rather than negative. Finally, the yield curve is only one of the financial indicators that researchers have found useful in predicting swings in economic activity. Other indicators that have had empirical success in the past, including corporate risk spreads, would seem to be consistent with continuing solid economic growth. In that regard, the fact that actual and implied volatilities of most financial prices remain subdued suggests that market participants do not harbor significant reservations about the economic outlook.

In the context of monetary policy, these principles suggest that policymakers should monitor bond yields carefully in judging the current state of the economy--but only in tandem with the signals from other important financial variables; direct readings on spending, production, and prices; and a goodly helping of qualitative



information. Ultimately, a robust approach to policymaking requires the use of multiple sources of information and multiple methods of analysis, combined with frequent reality checks. By not tying policy to a small set of forecast indicators, we may sacrifice some degree of simplicity, but we are less likely to be misled when a favored variable behaves in an unusual manner."

During the same period the ECB contributed to the debate.

ECB (February 2006): Does the flattening of the US yield curve signal lower growth ahead?

"The first reason why things could differ from the past is that this time the nearly inverted US yield curve seems to reflect particularly low long-term interest rates. The current historically low level of long-term interest rate in the United States may reflect exceptionally low risk premia that are driven by an unusually high demand for long-term bonds rather than by fundamental macroeconomic factors. In particular, the United States has witnessed a surge in foreign investment in US government bonds since the last recession in 2001.

Second, looking at survey evidence, the recently perceived likelihood of a US recession over the next four quarters is significantly lower than that derived from the aforementioned probit model with the term spread as the single explanatory variable. For example, according to the so-called “anxious index” published in the Federal Reserve Bank of Philadelphia’s Survey of Professional Forecasters in December 2005, 14% of all the panelists covered foresaw negative quarter-on-quarter real GDP growth at the end of 2006. According to the January 2006 Merrill Lynch Global Fund Manager Survey, 9% of the global fund managers responding shared the view that the US economy would be fairly or very likely to experience a recession over the next 12 months.

All in all, it is important to bear in mind that, at the current juncture, the US term spread could be distorted by a strong demand for long-term government bonds, the precise impact of which is rather difficult to quantify. More than just usual caution therefore seems warranted when interpreting recent developments in the US yield curve as an indicator of lower economic growth."

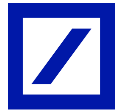
2001 Recession

We can't find as much commentary on the impact of the YC on the 2001 recession but this quote from the Fed's McDonough is another example of suggesting the YC inverted for reasons away from signaling a recession.

McDonough (February 2000): Bloomberg: Fed's William McDonough on Treasury Yield Curve:

"Typically, the inverted yield curve is seen as a sign of a coming recession, McDonough said. ''I don't see that as the explanation,'' he said. He said an expected drop in supply of long-term debt, as a result of reduced U.S. government debt sales and announced buybacks, is more likely the reason. Without those conditions, the inverted yield curve probably wouldn't exist, he said."

1990 recession

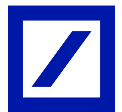


There is also little we could find on the YC and the 1990 recession but this article in the New York Times stands out as it claims low real yields offset the predictive quality of the YC.

New York Times (September 1989): Despite Skew Rates, Few Fear Recession

In the past, this inversion of the "yield curve" has often been a harbinger of economic downturns. But at the moment, the chances of a recession appear remote, the analysts said, in part because the inversion is slight in most countries and current conditions are far different than they were at the start of the decade.

"The difference between now and then is that inflation was running rampant back in the early 1980's, and in order to brake inflation and regain credibility, central banks were forced to drive real interest rates to record levels," said Nicholas Sargen, a director in bond market research at Salomon Brothers Inc. "Real interest rates around the globe are not as high now as they were then, and central banks won't have to push them up as high or keep them up as long."



Appendix 1

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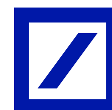

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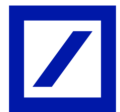

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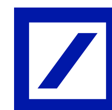

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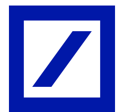

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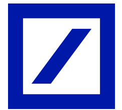

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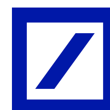

David Folkerts-Landau
Group Chief Economist and Global Head of Research

Pam Finelli
Global Chief Operating Officer
Research

Michael Spencer
Head of APAC Research

Steve Pollard
Head of Americas Research
Global Head of Equity Research

Anthony Klarman
Global Head of
Debt Research

Kinner Lakhani
Head of EMEA
Equity Research

Joe Liew
Head of APAC
Equity Research

Jim Reid
Global Head of
Thematic Research

Francis Yared
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George Saravelos
Head of FX Research

Peter Hooper
Global Head of
Economics Research

Andreas Neubauer
Head of Germany Research

Spyros Mesomeris
Global Head of Quantitative
and QIS Research

International Production Locations

Deutsche Bank AG
Deutsche Bank Place
Level 16
Corner of Hunter & Phillip Streets
Sydney, NSW 2000
Australia
Tel: (61) 2 8258 1234

Deutsche Bank AG
Mainzer Landstrasse 11-17
60329 Frankfurt am Main
Germany
Tel: (49) 69 910 00

Deutsche Bank AG
Filiale Hongkong
International Commerce Centre,
1 Austin Road West,Kowloon,
Hong Kong
Tel: (852) 2203 8888

Deutsche Securities Inc.
2-11-1 Nagatacho
Sanno Park Tower
Chiyoda-ku, Tokyo 100-6171
Japan
Tel: (81) 3 5156 6770

Deutsche Bank AG London
1 Great Winchester Street
London EC2N 2EQ
United Kingdom
Tel: (44) 20 7545 8000

Deutsche Bank Securities Inc.
60 Wall Street
New York, NY 10005
United States of America
Tel: (1) 212 250 2500