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August 2019

ON BUSINESS CYCLES...
and when Trend Following works

Executive Summary

The US just celebrated its longest economic expansion on record, with markets and policy makers anxious about a slowdown in global growth. Given any likely slowdown, investors may want to allocate more to defensive strategies in anticipation of a shift in the economic cycle. However, economic (or business) cycles are indistinctly defined, notoriously difficult to time, and, since each business cycle exhibit idiosyncratic features, unreliable as a repeatable investment conditioner. In lieu of depending on competing, 'official' definitions of business cycles, we propose a simple macroeconomic-quadrant model, which measures the "accelerating" and "decelerating" GDP and inflation dynamics of an economy. We then assess how a trend following strategy performs based on this objective business cycle definition.

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Introduction

Market commentators and policy makers are ostensibly uneased by the ageing US economic expansion. Now, after having registered the longest, sustained economic expansion on record,[1] investors are questioning whether an economic slowdown is inevitable, or a recession imminent.

Adding to this unease, is the International Monetary Fund (IMF) who, citing a flurry of geopolitical risks and an escalating trade war, revised down their short-to-medium term economic growth forecast for the US, along with *all* other developed nations.[2] The prospect of slower economic growth has prompted most major central banks to pivot towards looser monetary policy, also citing, for the most part, downcast economic growth prospects.

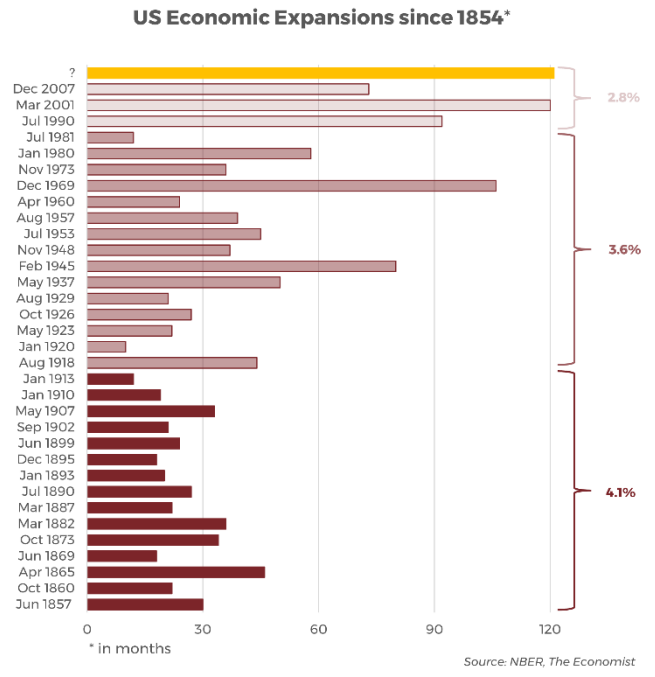

Figure 1: The bar chart shows the length, in months, of each economic expansion since 1854 accompanied by the date when the specific expansion reached a peak. This expansion has, of course, little in common with other periods of economic expansion. Moreover, post-mortems typically reveal business cycles have inherently different characteristics and are unlikely to be identical to any previous cycles. The most recent clusters of expansions have also shown lower rates of growth, with the last four expansions averaging 2.8%, compared to the 4.1% annual average growth rate of all the expansions from 1854 till the creation of the Federal Reserve and implementation of the US Revenue Act of 1913.

The US Federal Reserve (Fed), for one, has been making plenty of dovish noises, with designs of an "insurance" rate cut as per Jerome Powell, seemingly having materialised when the Fed Funds target rate was cut by 25 basis points on July 31.[3] Looking at the Fed's "dot-plot", a gauge of the average expected rate level from Fed voting members, shows the expected median Fed Funds rate for 2020 having fallen 50 basis points between the March and June FOMC meetings.[4]

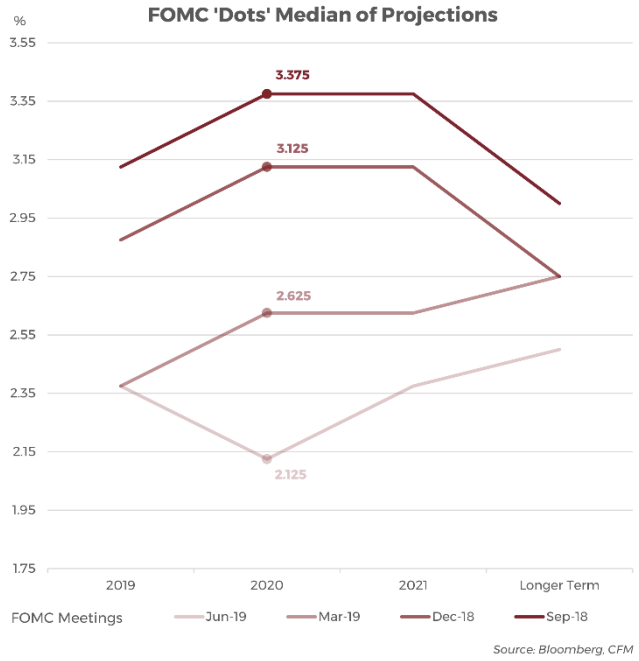

Figure 2: The individual curves of the median of the FOMC members' projected level of the Fed Funds rate. At the last meeting which included a package of 'Projection Materials' (see footnote 4), the median outlook for the Fed funds rate for 2019 was 2.375%, down from the 2.875% at the December FOMC meeting. Expectations have continuously been lowered during the last four meetings. The Fed hinted strongly in early June of monetary policy easing, stating that they "will act as appropriate to sustain the expansion."

With divergent performance between asset classes within different business cycles commonly understood, investors may contemplate shifting exposure to those strategies, asset classes, or equity sectors that have typically performed better in an economic slowdown/recession.[5] However, timing strategies using any anticipatory, or

[1] The US Economy entered uncharted territory, when, in June 2019, it registered a 121-month economic expansion – the longest since records began in 1854. The title for the longest expansion of any developed economy is, however, still held by Australia, which, as at the end of Q2 2019, boasts an uninterrupted 28 year economic expansion.

[2] In the April 2019 *World Economic Outlook* (WEO), the IMF downwardly revised global growth expectations by an average of 0.4 and 0.1 percentage points for 2019 and 2020 respectively, from the October 2018 WEO.

[3] The European Central Bank is set to follow suit, with outgoing President Mario Draghi using the opportunity of the ECB's annual conference in Sintra in June to confirm that "...In the absence of improvement, such that the sustained return of inflation to our aim is threatened, additional stimulus will be required."

[4] Those FOMC meetings at which the FOMC releases a package of 'Projection Materials' that include the members' assessment of "appropriate monetary policy."

[5] 'Safe-haven' sovereign bond yields have recently tumbled: the US 10-year yield fell 60 basis points by July 31, and not before slipping briefly below the 2% level during the final week of June, and again during the first week of July.

forecast-based approach assumes an ability to accurately and consistently predict a change in a cycle. Moreover, the classification of a business cycle is ambiguous, and pinpointing frontiers between different phases of the cycles a challenge.

The temptation is, nevertheless, strong.

Geared with the knowledge that trend following shows comparable performance across different, conventionally defined business cycles, we review this strategy's performance in an alternative, and impartial classification of an economic regime.

We conceived and constructed, as such, an objective economic regime description – consisting of four unique quadrants – that significantly reduces the definitional ambiguity of traditional business cycle classifications. We show, primarily, that the returns of a generic trend following strategy, exhibit no statistically significant sensitivity to our definition of an 'accelerating' or 'decelerating' business cycle. Moreover, a generic trend following strategy delivers a comparable magnitude of returns in each of our four distinct economic regimes.

A quick refresher: what is a business cycle?

There is an immense body of literature on the theory of business cycles, often accompanied by inconsistent, yet synonymously used terminology. Most readers will however recognise the emblematic four-phase representation of a business cycle as in Figure 3 below, which illustrates and describes the fluctuations (often called the output gap[6]) in the level of economic activity around a long term growth trend.

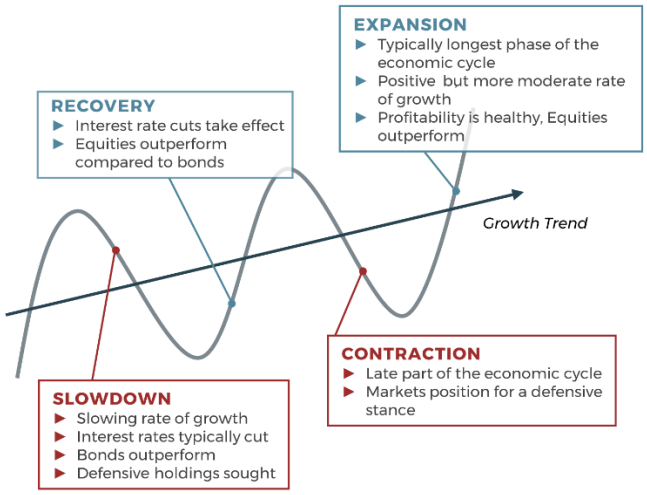

Figure 3: The typical business cycle as proposed by Burns and Mitchell (1946), depicting the aggregate output (real GDP) over time, showing how economic activity fluctuates around a long-term GDP growth trend.

How are the phases of the business cycle defined?

In the US, 'dating' of business cycles is the responsibility of the 'Business Cycle Dating Committee' of the National Bureau of Economic Research (NBER). The NBER "does not have a fixed definition of economic activity", but, instead, examines a broad variety of measures and indicators. This approach attempts to identify local maxima and minima of selected time series' to determine 'peaks' (after an expansionary phase), and 'troughs' (following a contraction phase) of economic activity. Their dating is not an entirely trivial exercise, as various government agencies rely on this dating for their own work.

The United States is one of only a few countries, (also notably Japan[7]), that does not follow the broadly used definition of a recession being *two consecutive quarters of negative GDP growth* – what many economists refer to as a 'technical recession' for knowing when an economy is heading for, or finding itself in a recession.

There are advantages and drawbacks to both these dating approaches.

Following the technical recession definition is both timely and objective: policy makers need only wait until the next publication of GDP data.[8] However, GDP data is subject to non-trivial revisions. See Table 1.

[6] The output gap is defined as the deviation of the GDP trend from the potential, or 'natural' GDP, i.e. the highest theoretical output that an economy could sustain over the long term.

[7] In Japan, not much unlike the US, the dating of business cycle turning points rest under the purview of an 'independent' panel, based on monthly data published by the Economics and Social Research Institute in the Cabinet Office (ESRI). The government panel retroactively determines the length of economic cycles, a process which has a lag of more than a year.

[8] Quarterly GDP data is released with a lag of no more than a couple of months.

But importing a lag in 'certifying' an economic recession, such as the NBER, also has its own pros and cons. While this method does avoid the problem of significant revisions, it suffers from a long lag – a year or more, when an economy may already be deep into a slowdown or recession. This approach lends itself to the risk of policy measures not being enacted, that could (should) have been deployed earlier.[9]

GDP revisions in the US*	
GDP Vintage	**Average revision (in annual percentage points)**
Advance to Second	± 0.5
Advance to Third	± 0.6
Second to Third	± 0.2
Advance to Latest	± 1.2

Table 1: In the US, the Bureau of Economic Analysis (BEA) releases a series of estimates, subject to revisions as more comprehensive information becomes available. The average GDP revision varies from as little as ±0.2, to as much as ±1.2 between the first (Advance) to the final (Latest) release. Policy relying on advanced GDP readings could fall victim to revisions, where, for example, an erstwhile recession could be wiped away with a subsequent revision, making the enacting of certain policies, possibly, unnecessary or unwanted.
*Source: Bureau of Economic Analysis.

Markets know this, and might want to rely on other metrics, or often, certain 'Leading Economic Indicators' (LEIs), to make a more timely assessment of the state of the economy. One common indicator, a favourite short hand harbinger of recessions, is the spread monitored for inversion between the US 3-month/10-year, which has preceded every one of the last seven US recessions. This spread has slipped in and out of an inversion since March of earlier this year, and, as of the end of Q2 2019, remained inverted.

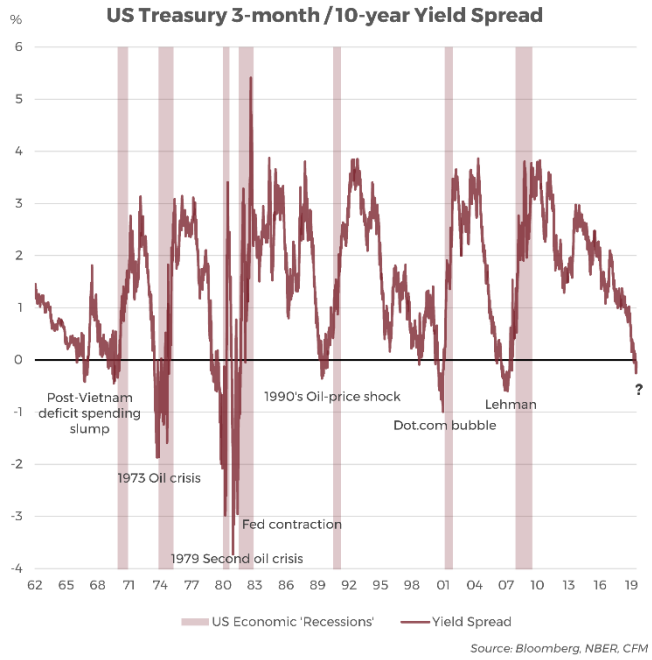

Figure 4: The US 3-month/10-year tenor spread inverted in March. A yield curve inversion between these two tenors has preceded each of the last seven US recessions. However, the yield curve has inverted on occasions without the US economy slipping into a recession. Many other LEI shows similar noise in their ability to predict recessions with any statistically significant accuracy.

Macro quadrant proposal

Although research have shown that trend following earns positive returns in different phases of the business cycle,[10] it has typically been done by at least using the official NBER definition of business cycles of the US, or, comparing the performance of trend following under the scenario of a recession as per the technical definition.

We are interested to ascertain whether trend following also works in an alternative definition of business cycles.[11]

In order to sidestep the definitional ambiguity, and discrepancy between competing domestic approaches of business cycle identification, we propose an intuitive – and simple – alternative. We construct, in the spirit of the '4-Quadrant model', a similar 'Macroeconomic Quadrant' (MEQ) model of four unique economic regimes, but, by measuring and combining the 'acceleration' or 'deceleration' of GDP and inflation as in Figure 5.

In this model, we use the sign of a 4-quarter minus a 20-quarter trend in order to timely detect whether the underlying macroeconomic variables, GDP and inflation

[9] Mexico is another country that recently alluded to its dismay about the unnecessary rigidity of using the traditional technical definition of a recession. A Mexican Central Bank board member, Jonathan Heath, recently recently called the two quarter negative GDP growth definition a "rule of thumb for defining a recession" but "no guarantee."

[10] See for instance Hutchinson. M, and O'Brien. J, "Time Series Momentum and Macroeconomic Risk", or Rennison. G, Dorsten. M, "Trend-Following Through the Rates Cycle".

[11] This work may also inform our future research on whether one could use this information to condition exposure to different risk premia, depending on the stage of the business cycle.

are 'accelerating' or 'decelerating'. Of course, the choice of the trend timescales is arbitrary, but we believe that the 1-year over 5-year trend is reasonable.

	Accelerating Inflation	Decelerating Inflation
Accelerating GDP	GDP_{acc} & Inf_{acc}	GDP_{acc} & Inf_{dec}
Decelerating GDP	GDP_{dec} & Inf_{acc}	GDP_{dec} & Inf_{dec}

Figure 5: The economic quadrant model showing the four distinct regimes defined and combined by either accelerating/decelerating GDP or inflation.

There are various benefits to this classification of an economic regime.

First, as is the case when using the technical definition of recession, using a mechanical macro trend indicator is unambiguous, universally applicable across countries and introduces well-defined boundaries.

Second, this approach is level independent and thus avoids the need for arbitrary reference levels. The global economy has experienced sustained, yet low growth rates since the GFC.[12] By using this measure, one can detect subtle shifts over the entire period. In fact, the very definition of high/low-growth regimes strikes us as very country dependent and, as a consequence, subjective. Our focus on the direction of change instead of the level completely removes this ambiguity.[13]

Finally, once the timescales have been fixed, the definition of accelerating or decelerating regime is definite. Some macroeconomic variables, like sovereign bond yields in developed countries, exhibit long-term trends in one direction. For such variables, the total length of the accelerating regime and the decelerating regime will be very different. Nevertheless, the number of data points in the shorter of both regimes is by far greater than we would have at our disposal if we stuck to the conventional definitions of expansion/contraction. This greatly improves the statistical significance of the study.

Methodology and data

- We use real GDP growth and inflation since both variables are of pivotal importance for any economy.[14] The first captures the condition of the economy, while the latter reflects changes in the purchasing power of the domestic currency. It is well known that both variables are among the most important indicators central banks assess when setting monetary policy. Furthermore, prices of almost every tradable asset are sensitive to at least one of these variables. Stocks typically perform well in economic expansions, while bonds typically perform worse when inflation accelerates. Commodities are directly influenced by domestic (and worldwide) consumption and thus linked to GDP. Finally, the price of every currency depends on its ability to store value and thus is related to inflation.
- Recessions may be deflationary or inflationary, usually depending on the amount of debt denominated in foreign currencies and/or the amount of "hot money" from foreign investment in the economy. Similarly, economic expansions are not necessarily accompanied by accelerating inflation.
- The direction of change in both variables, while not completely independent, allows for the isolation of four distinct economic regimes as illustrated in Figure 5.
- We assign nationality to every futures contract in our pool: this is straightforward for most of the index, bond and STIR futures, exceptions being the MSCI Emerging Market, EUROSTOXX, and EURIBOR futures for which we calculate the average of the main economies related to each contract. Every index, bond or STIR future is thus allotted a signed trend of the domestic macroeconomic variable or a signed equally-weighted average of relevant macroeconomic variable trends.
- For currency pairs, we subtract the trend of the variable currency from the trend of the fixed currency before taking the sign, for example: we first subtract the inflation trend in the US from that in the Eurozone when looking at the EUR/USD exchange rate and only then sign the result.
- For commodities, we decided to draw up a list of main global economies and equally weight the corresponding signed trends before taking the sign. The alternative would be to use the currency of the contract to determine "nationality".

[12] While the economies of most developed countries have shown positive growth, the magnitude of this growth has been much lower than in other periods of expansion. See for instance again Figure 1 above, which shows the slowing growth rate of economic expansions.

[13] We thus, for example, clearly detect the slowdown of the growth rate of the Chinese economy that has been making headlines. The real Chinese GDP growth rate, however, still stands at more than 6% per annum, so the economy is very far from a contractionary regime. It is not even clear whether the current reading should be interpreted as a high or low growth regime.

[14] We use the seasonally adjusted, real YoY GDP growth rate of 27 countries extracted from the database of the OECD and others. We source Consumer Price Index (CPI) data mostly from IMF, but complement it with different sources if necessary. If the publication frequency is monthly, we resample the inflation data quarterly by taking the mean of the three months constituting a quarter.

- We define accelerating environment for a given contract as all quarters in which the trend indicator of the associated macro variable has a positive sign. (The same procedure is applied for a decelerating environment.)
- Since we use two different economic variables, the real YoY GDP growth and inflation, we dissect the time series of each contract in the pool into 4 separate subsets.

Trend-following strategy

We construct a generic trend following strategy, which is an exponentially weighted 6-month moving average returns trend indicator, as follows:

$$S_n(t) = \sqrt{260}\, EMA_n^{t-1}\left(\frac{(X(t))}{\sigma_n^{t-1}}\right)$$

Where

n = 21 business days*6 ≈ 6 months;

X = price returns;

σ = rolling standard deviation of returns

We apply this predictor to a set of ~100 fixed income, equity index, FX and commodity future contracts.

We explain how we compute the returns of each quadrant by taking the example of the $GDP_{acc}Inf_{acc}$ quadrant. The construction of the other 3 quadrants follows a similar recipe.

On every business day starting from the beginning of the backtest, we select those contracts for which:

- The returns of the trend strategy constructed above is available;[15]
- Both the GDP and inflation trends have a positive sign on that day.[16]

Finally, we compute the average returns for the day by averaging over the selected contracts.

Results

Our results show that a generic trend following strategy delivers good historical performance, in each of the unique states of the economy as per our objective definition of an economic regime. See Figure 6.

	Accelerating Inflation	Decelerating Inflation
Accelerating GDP	SR = 0.86	SR = 1.11
Decelerating GDP	SR = 0.78	SR = 0.71

Figure 6: Performance of risk-managed PnLs per quadrant shows that trend following delivers positive performance in each of the economic regimes.

These results are consistent with other attempts at matching the effects of macroeconomic regimes (and regime changes) on the performance of trend following, except, we propose what we believe to be an objective, unambiguous tag or description of a business cycle, universally applicable, and which can be applied consistent across regions.[17]

Research to test the performance of other conventional risk premia within the same (and extended) quadrant model is under way. Stay tuned.

Conclusion

Investors have traditionally called upon trend following as a strategic addition to their portfolio during times of heightened recessionary pressure. Trend following as an option-replicating-like strategy (only, typically much cheaper), which profits from fat-tailed events like market sell-offs, have been shown to offer protection in market drawdowns.[18]

This study confirms that a generic trend following strategy not only delivers positive performance in a 'decelerating' economic environment, but delivers comparable,

[15] Some contracts enter the pool later than others for various reasons: a) the contract itself has not been traded before, b) the quality of data in the past was insufficient for accurate mark-to-market, c) the underlying did not exist before (e.g. the euro was only introduced in 1999, etc.)

[16] We use quarterly GDP and inflation data. We assume no lag between the value date and the announcement date. After we compute the trend signals we resample them to business days by backfilling the entire quarter using the value for the quarter. Our study is thus non-causal. We are, as such, agnostic to revisions and do not require point-in-time macroeconomic data since the purposes of this study is simply to 'stress test' trend following over different economic cycles.

[17] Our earlier work has delivered similar result, showing that trend following strategies deliver comparable returns in different interest rate environments. See the technical note "CTAs in a regime of rising rates" available on the CFM website. https://www.cfm.fr/insights/ctas-in-a-regime-of-rising-rates/.

[18] Interested readers are referred to our whitepaper "The Convexity of Trend Following" available on the CFM website: https://www.cfm.fr/insights/the-convexity-of-trend-following/.

consistent returns in *all* phases within our definitional framework of a business cycle. Our approach not so much replaces, as complements research that has shown that trend following strategies deliver positive returns in the different stages of traditionally, and alternatively defined business cycles.[19]

These results further strengthen our belief that trend following is a robust, all season strategy that delivers consistent returns irrespective of underlying macroeconomic conditions.

We show, that investors need not revisit the question as to whether trend following works in economic downturns, but focus how the strategy works in *all* economic environments, including in a universally defined expansion or contraction environment.

Disclaimer

[19] See similar results found by Ilmanen. A, et al. "Factor Premia and Factor Timing: A Century of Evidence."

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