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Can This Expansion Last Forever?

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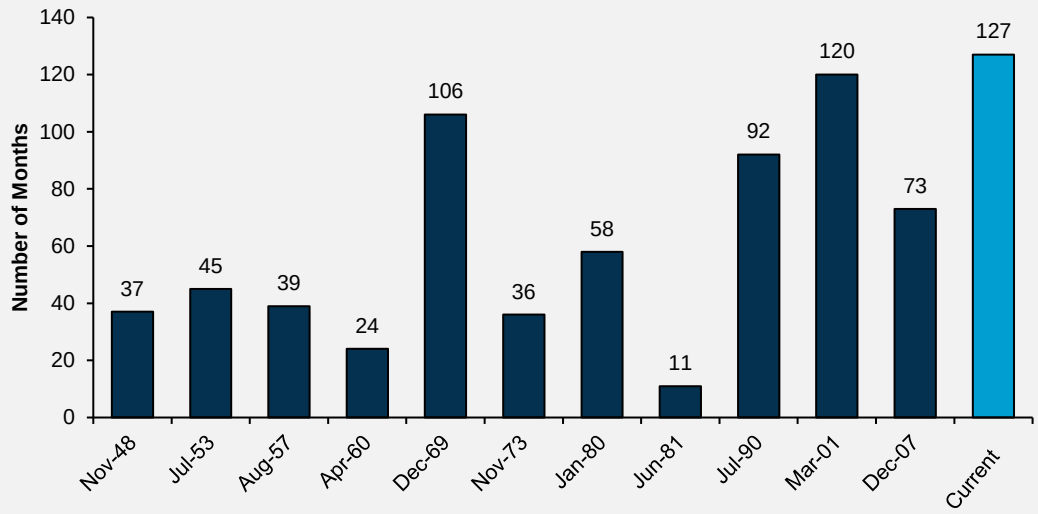
The expansion of the U.S. economy following the global financial crisis has been slower than those after previous post-war recessions. Since 2010, growth has averaged around 2.3%, compared with over 3.0% in previous expansions. But if the current business cycle has disappointed in its pace, it has also distinguished itself in terms of its longevity of 127 months—the longest expansion of the post-war period. With most observers expecting growth to continue through 2020, this record seems likely to lengthen further.

The longevity observed in this cycle has also been a feature, albeit to a lesser extent, of other recent U.S. expansions. As shown in Figure 1, the last four have averaged over 100 months and include four of the five longest post-war cycles. In contrast, earlier expansions averaged less than 50 months.

Figure 1: Length of U.S. Economic Expansions*



*Source: PGIM Fixed Income and Haver Analytics. *Number of months from trough to peak.*

The deeper question is why business cycles have lengthened. One explanation is improved economic management—the Federal Reserve is better at keeping the economy on an even keel. The increased focus on financial stability and regulation since the crisis may be further contributing to this end. Another, less upbeat explanation, is that there is less underlying dynamism in the economy. Excess animal spirits that manifest themselves via macroeconomic imbalances, such as high inflation or sharply rising commodity prices, are now less likely. An important issue for the current cycle is whether animal spirits are—and will remain—sufficiently restrained in financial markets.

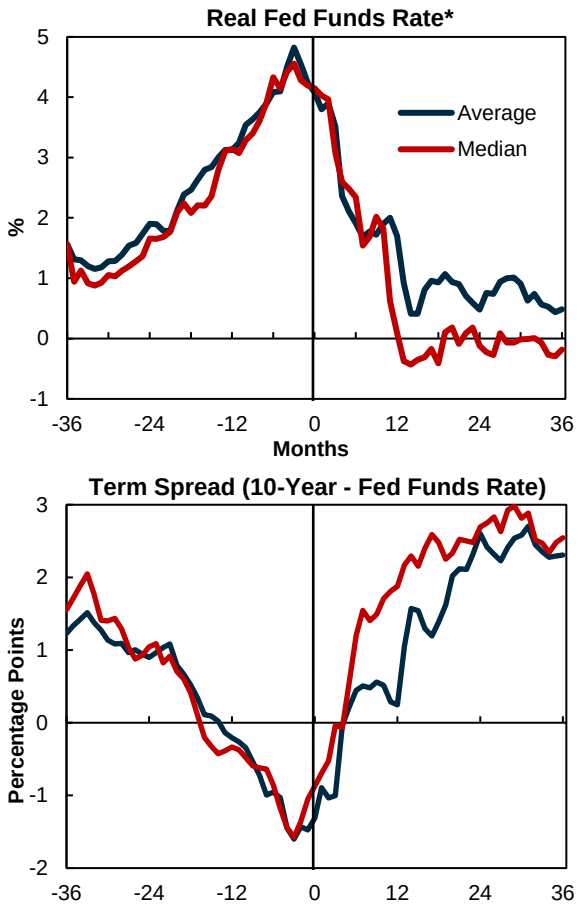
With this preface, we turn to several questions. First, how likely is the U.S. economy to fall into recession during the coming year? Second, what variables best predict the onset of U.S. recessions? Third, and more fundamentally, what can be said about the underlying dynamics of U.S. business cycles, and how have these dynamics shifted over time?

Our work suggests several conclusions. First, U.S. business cycles exhibit common features, notwithstanding the apparent heterogeneities of their underlying drivers and the circumstances that have led to their demise. For example, a tightening of monetary policy, an inversion of the yield curve, and a rise in initial unemployment claims has preceded each recession over the past 50 years. Second, these systematic relationships can be exploited to evaluate the probability of recession. We find the likelihood of a U.S. recession at present to be low. Even so, the recent outbreak of the coronavirus highlights that it's always necessary to monitor for new and diverse risks which could unexpectedly end the expansion. Third, we also find evidence of stall-speed behavior in the data. Specifically, once the economy has slowed sufficiently, the risks of sharper slowdown—and of recession—are amplified. The current U.S. data, however, remain comfortably above their stall speeds. Finally, our work also sheds light on the shifting dynamics of U.S. recessions. We see evidence that the yield curve may be losing some efficacy as a recession indicator (see the accompanying box for more on the yield curve). On the other hand, the evolution of balance sheet variables, particularly measures of credit and indebtedness, seem more powerful than they were two or three decades ago.

Given the notable similarities between the cyclical performance of the United States and that of the rest of the world, many of these conclusions equally apply to the global business cycle as well. We sketch out these considerations in the concluding section.[1]

Characteristics of U.S. Recessions

Figure 2: U.S. Business Cycle Indicators



Note: t=0 is the peak of the business cycle.
**Calculated using trailing 12-month core PCE inflation.*

Each post-war U.S. business cycle its own unique narrative. These expansions have not died of old age, but something has eventually killed them. In some cycles, inflation was high, and the Fed responded by hiking rates to curtail additional inflationary pressure. In other expansions, particularly during the two last decades, asset prices and credit extension reached unsustainable levels and adjusted abruptly downward. Still, other recessions were triggered, or amplified, by shocks to the price of oil and other commodities. Further, over our five-decade sample, there have been significant structural changes in the U.S. economy.

What is striking, however, is that despite this heterogeneity across cycles, certain common developments have characterized the onset of U.S. recessions. In other words, we can identify economic and financial variables that have systematically served as leading indicators of business-cycle downturns.

Figure 2 highlights a few examples. These panels display each of the indicated variables in the months before a business-cycle peak (month 0) and then in the period after the peak.[2] The blue line shows the average for a given variable at a given point in the cycle across expansions back to 1969. The red line shows the median. (We report the disaggregated data for these cycles in the Appendix.)

As illustrated in the first panel, these cycles have seen a tightening of monetary policy in the years before the peak. Strikingly, however, real policy rates have generally been cut in the months immediately before the recession, suggesting that the Fed has tended to overtighten. This observation is consistent with the

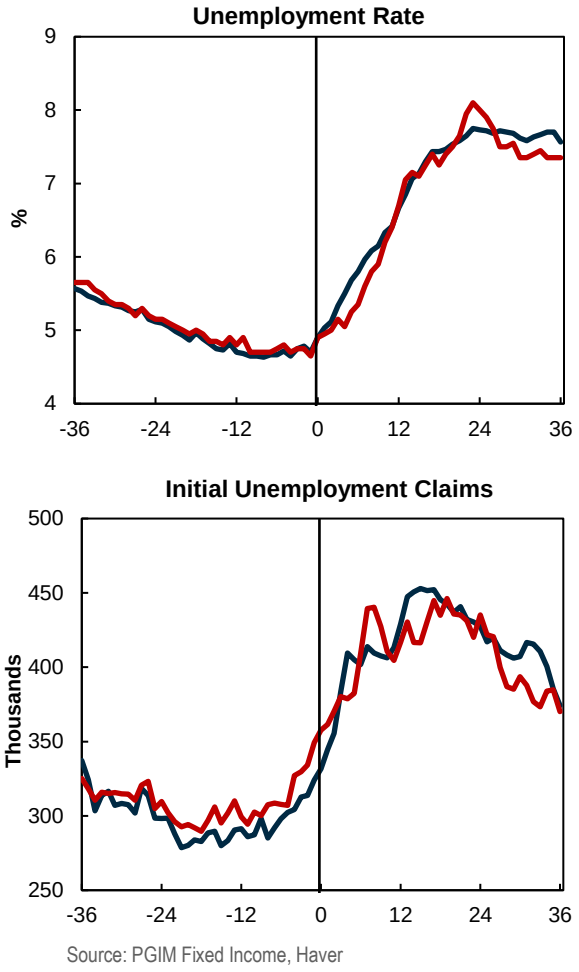
[1] *We thank Arvind Rajan for thoughtful conversations and Hilda Sanchez for excellent support.*
[2] *We exclude the 1982 recession here, as well as in Figure 6 and Figure 9 below. As the second dip in a double-dip recession, the economic features of that downturn, and the conditions that preceded it, were structurally different from those before other recessions.*

quip about monetary policy—"the last rate hike in a tightening cycle is always a mistake." It also seems consistent with the stronger corollary that the Fed eventually kills expansions.[3]

A second strong commonality across the cycles is that the yield curve inverts. For example, the spread between the 10-year Treasury yield and federal funds rate inverts roughly 15 months before the cycle peak, but the inversion has typically begun to unwind by the time the recession begins. The exact dynamics of the inversion differ across various measures of the yield curve, but the story is broadly similar.

The final two panels focus on the labor market. At the time that the recession begins, the unemployment rate has been flat for roughly a year, but has not yet started rising. This underscores that the unemployment rate tends to be a lagging indicator of the economy's performance. Initial unemployment claims, however, prove to be a better leading indicator. Initial claims start rising roughly a year before the end of the expansion and then continue rising through the first year of the recession.

The behavior of these variables establishes intuition for our work in the remainder of the paper. We search across a broad set of macro and financial series seeking those that are reliable leading indicators of recession.



Source: PGIM Fixed Income, Haver

Estimating Recession Probabilities

In this section, we construct a framework that draws on macro and financial data to assess the probability of a forthcoming recession. We seek to determine which variables are highly correlated with subsequent recessionary events. More specifically, we estimate a logistic (or "logit") regression model in which the dependent variable is equal to one if the economy is in recession during any of the next twelve months and zero otherwise.[4] The explanatory variables are a broad set of macro and financial variables, many of which have been used as business cycle indicators. Our list includes, but extends well beyond, those used by the National Bureau of Economic Research to identify business-cycle peaks and troughs. Our estimation employs monthly data beginning in 1965.

As shown in Figure 3, we start with a battery of 85 data series which we divide into four broad categories—economic variables, financial variables, price variables, and credit variables. We first run a series of bivariate regressions to assess the explanatory power of each of these variables on its own. The highlighted variables, which have bilateral t-statistics of over 10, are included in our "baseline" model (Figure 4).[5] None of the credit variables make the cut, but we reintroduce them in the following section.

[3] *See the discussion between Ben Bernanke and Janet Yellen at the 2019 meetings of the American Economics Association as reported, for example, in "Do Economic Booms Dies of Old Age?," January 11, 2019.*

[4] *This definition of the dependent variable includes both the twelve months before the recession begins and each month that the economy is actually in recession (except the last month).*

[5] *If several variables were highly similar conceptually (e.g., housing permits and housing starts, or various measures of the yield curve), we selected the one with the highest t-stat.*

Figure 3: Recession Model Variable Selection

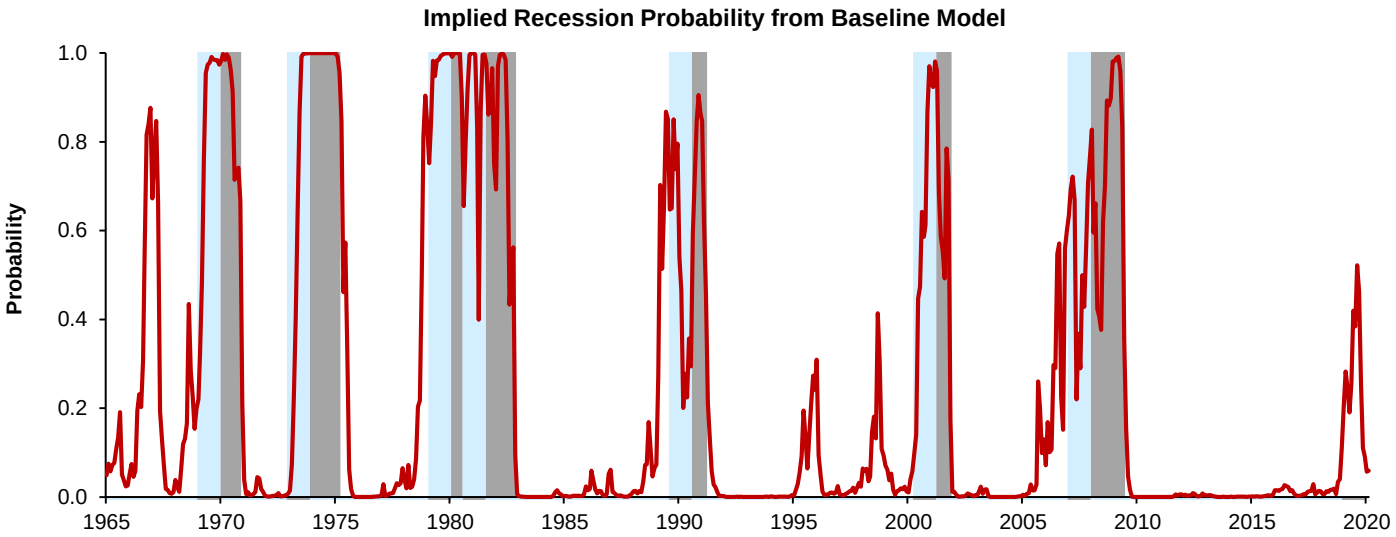
		t-stat*		t-stat
Economic Variables	***Housing Permits***	***-11.2***	ISM Mfg: PMI Composite Index	-8.4
	U-Mich: Consumer Confidence Present	***-11.1***	Total Capacity Utilization	-8.0
	Housing Starts	-11.1	Home Builders: Housing Market Index	-8.0
	Real PCE: Goods	***-10.3***	Unemployment Rate	7.8
	Real Retail Sales	-10.2	NFIB: Small Business Confidence	-7.4
	Initial Unemployment Claims	***10.2***	Industrial Production	-7.0
	CEO Confidence	-9.7	IP Non-Industrial Supplies	-7.0
	Motor Vehicle Sales	-9.7	IP Materials	-6.9
	Nonfarm Payrolls	-9.5	IP Final Goods	-6.5
	IP Motor Vehicles	-9.5	Orders: Real Non-Defense Capital Goods	-5.6
	U-Mich: Consumer Confidence Future	-9.5	Real Personal Income	-5.3
	Average Weekly Hours	-9.4	Economic Policy Uncertainty	5.3
	Nonfarm Payrolls	-9.3	Real PCE: Services	-4.6
	Conference Board: Future Confidence	-9.2	Utilities Capacity Utilization	-4.2
	Conference Board: Present Confidence	-9.1	Economic Policy Uncertainty	-3.9
	Average Weekly Hours	-9.1	ISM Mfg: Supplier Deliveries Index	-2.9
	Manufacturing Capacity Utilization	-8.8	Tech Capacity Utilization	-2.7
	Bank Lending Survey	8.7	Real Wholesale Sales	-0.8
	Shipments: Real Durable Goods	-8.6	Mining Capacity Utilization	-0.2
Financial Variables	***Term Spread 10Y UST - Fed Funds***	***-11.2***	Term Spread 2Y UST - 1Y UST	-8.4
	Term Spread 5Y UST - Fed Funds	-11.1	Term Spread 5Y UST - 2Y UST	-8.3
	Term Spread 3M UST - Fed Funds	-11.1	Nasdaq Index	-8.1
	Nonfinancial Commercial Paper Spread	***10.5***	Term Spread 10Y UST - 2Y UST	-8.1
	Term Spread 1Y UST - Fed Funds	-10.5	Term Spread 30Y UST - 10Y UST	-7.8
	Term Spread 10Y UST - 3M UST	-10.1	S&P500 Financials Index	-7.7
	Real S&P500 Index	***-10.1***	Real M1 Money Supply	-7.7
	Case-Shiller Cyclically Adjusted P/E	-9.7	TED Spread	6.3
	Real Fed Funds Rate	9.6	Financial Commercial Paper Spread	6.3
	Term Spread 30Y UST - Fed Funds	-9.3	M1 Money Supply	-3.9
	Term Spread 2Y UST - Fed Funds	-9.2	GZ Spread	3.6
	Excess Bond Premium	9.1	Fed Funds Rate	3.5
	S&P500 Index	-8.8	S&P500 Realized Volatility	2.9
	Real Case-Shiller House Price Index	-8.8	Case-Shiller House Price Index	-2.0
	Real M2 Money Supply	-8.7	M2 Money Supply	1.4
	Term Spread 10Y UST - 5Y UST	-8.6	Term Spread 1Y UST - 3M UST	-1.2
Price Variables	***Average Hourly Earnings***	***10.5***	WTI Price	5.8
	Core CPI Inflation	9.7	Core PPI Intermediate Goods	5.7
	Core PCE Inflation	9.0	Non-Fuel Commodity Price	4.4
	Core PPI Finished Goods	8.0	Non-Petroleum Import Price	2.2
	Real Average Hourly Earnings	-7.9	Core PPI Crude Goods	-1.6
Credit Variables	Nonfinancial Business Credit to GDP	7.9	Credit to Income (Households)	-3.3
	Total Private Nonfinancial Credit to GDP	6.0	Household Credit to GDP	1.9
	BIS Credit Gap	5.8		

*Source: PGIM Fixed Income. *Bivariate logistic regressions.*

The strongest performers in our baseline model are the term spread and initial claims. Consumer confidence and real equity returns also contribute significantly. The other four variables are not statistically significant here, but they perform well in several other regressions detailed below.[6] We interpret an estimated probability of greater than 50% as a signal of recession.

Figure 4: Baseline Model (January 1965-February 2020)

Average Hourly Earnings	U-Mich: Consumer Confidence Present*
Initial Unemployment Claims*	Term Spread (10 Year - Fed Funds)*
Housing Permits	Real S&P 500 Index*
Real PCE: Goods	Nonfinancial Commercial Paper Spread



*Source: PGIM Fixed Income. *Significant at the 5% level. Note: Grey shading indicates recession months; light blue shading indicated the 12 months prior to recession.*

As highlighted in the graph, the model generally does a good job of predicting recessions. It incorrectly called a downturn in the late 1960s, but since then, a probability of more than 50% has preceded a recession by seven to 18 months. Furthermore, except for the false positive in the late 1960s and a couple of wobbles in the late 1990s, a probability of even 30% has been a reliable signal.

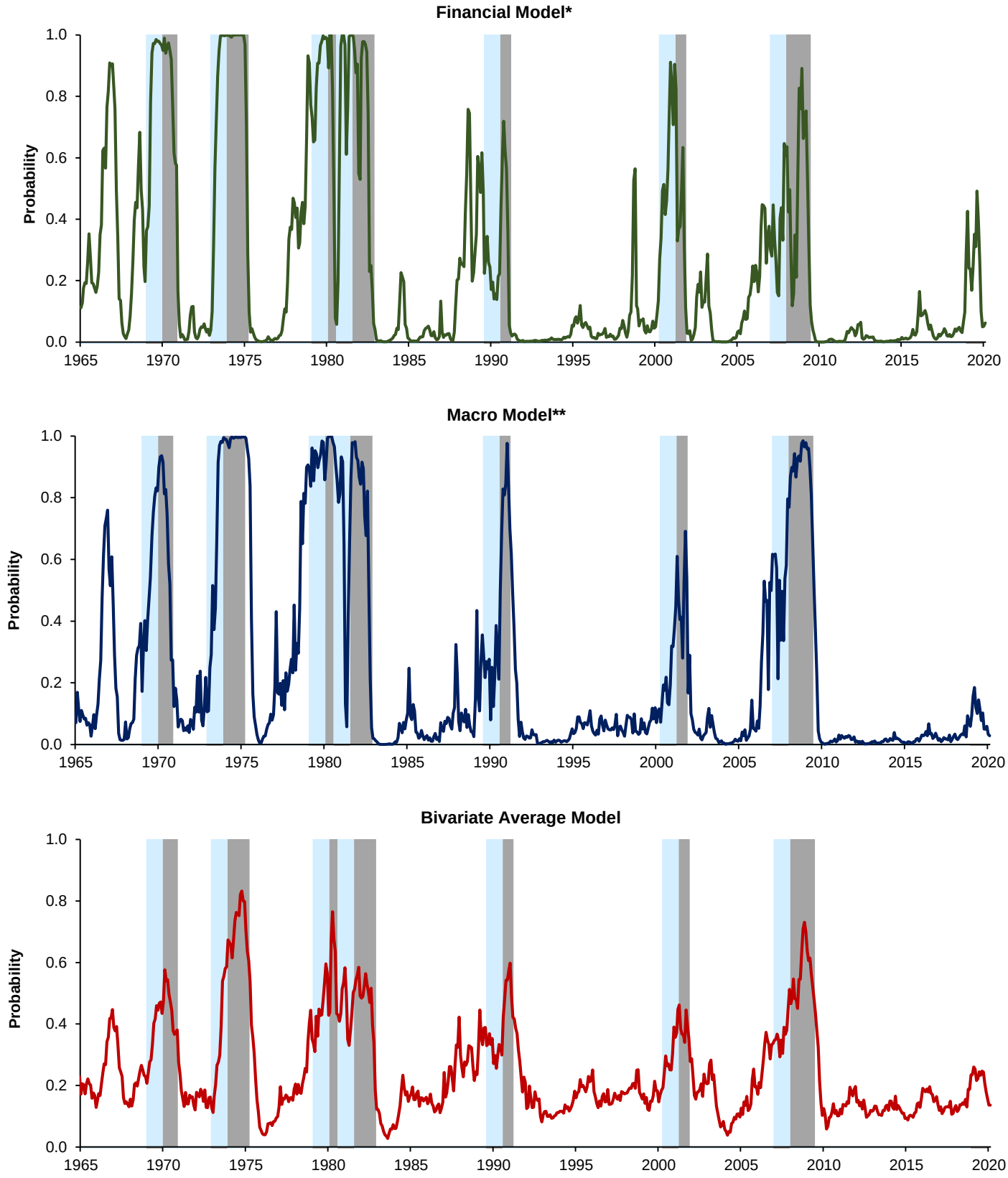
Notably, in August 2019, the model's recession probability spiked above 50% mainly reflecting an inversion of the yield curve. The model exceeded 50% for only one month, and it was back below 30% by October. Nevertheless, if a recession does not occur by August 2020—an outcome that the model's current reading and our judgmental assessment sees as unlikely—this episode will represent another false positive. This raises questions as to whether the predictive power of the term spread has declined in the aftermath of the global financial crisis, an issue that we address in the following box.

As a complementary cut of the data, we also estimate three auxiliary models (Figure 5). The first employs the three financial variables in our baseline framework. This model has tracked recessions well, but it has tended to be more volatile than the baseline. The second model uses the five macro variables. The resulting probabilities have been more stable than those from the financial model, but it has lagged in calling recessions. Thus, the financial model is useful for flagging recession risks and the need for intensified monitoring, while the macro model is better for confirming the onset of recession. This pattern played out strikingly in 2019 when the inverted yield curve caused the financial model to spike upward, but the increase in the macro model was much more restrained.[7] Both of these models indicate that the probability of a recession is roughly 5%.

[6] *The variables are defined as 12-month changes, except the term spread and the commercial paper spread. We also looked at the performance of three-month changes and other transformations of the data, but the 12-month change was generally most powerful. Another data issue we faced is that the non-financial commercial paper spread begins only in 1971. We backcast the series using the financial commercial paper spread and the fed funds rate.*

[7] *A related point is that the logit model is non-linear and, hence, the recession probabilities of the baseline model shown in Figure 4 are not simply a weighted average of those from the financial and macro models. Rather, it seeks to use the interactions between the financial and macro variables to get a clearer read on recession probabilities.*

Figure 5: Implied Recession Probability from Alternative Models



*Source: PGIM Fixed Income. *Financial Variables: Term Spread, Real S&P500 Index, and the Nonfinancial Commercial Paper Spread. **Macro Variables: Initial Unemployment Claims, Housing Permits, Real PCE: Goods, Consumer Confidence, and Average Hourly Earnings.*

The bottom panel shows the results from a third approach. We first run a separate bivariate logit model for each of the eight variables in the baseline model. We then take a simple average of the estimated recession probabilities across these models at each point in time. The results have several appealing properties. First, in "normal" times, the estimates hover around 20%, roughly the unconditional probability of recession. Affirmatively good data are required to drive the probability downward, and bad data are needed to push it upward.[8] Second, the model never goes precisely to zero or all the way to 100%. This comports with our intuition that we can never be absolutely certain that a recession will, or will not, happen within a 12-month window.[9]

Figure 6 provides further appraisal of these models. In particular, when each model has signaled a recession, we report the number of months until the recession starts and the number of false positives. Given the natural volatility of the data, these assessments sometimes require significant judgement. As expected, the baseline model performs well, with an average lead time of 13 months and only one false positive since 1965. The financial model is nearly as good—it also signaled 13 months ahead, and it had just two false positives. However, it was slow flagging the global financial crisis. Notably, both models signaled recession in mid-2019 with the inversion of the yield curve, so their false positives are likely to click up by one. By comparison, the macro model is slower to signal, but its signals have proved quite reliable. Finally, the average of the bivariate regressions puts in a strong performance, signaling 16 months ahead on average and recording just one false positive.[10]

Figure 6: Performance of Alternative Models (Months Prior to Recession)

	Recession Start						Average	False +
	Jan 70	*Dec 73*	*Feb 80*	*Aug 90*	*Apr 01*	*Jan 08*		
Baseline	9	7	16	17	8	18	13	1*
Macro	6	8	18	0	0	18	8	1
Financial	18	9	16	25	9	2	13	2*
Average of Bivariate	8	6	16	34	10	19	16	1

*Source: PGIM Fixed Income. *False positives will increase by 1 if a recession does not follow from the recent signal of these models.*

In sum, given these results, we feel some guarded confidence in our ability to forecast recessions. Although the structure of the U.S. economy continues to evolve, we see systematic similarities across cycles. It's reasonable to conjecture that these relationships will remain intact. Even if this time is different, it won't be *so* different as to fully invalidate these long-established relationships. More proximately, our models indicate that the probability of recession in the United States over the coming year is low.

Is There Evidence of Stall Speeds?

The previous section combines the data into a single model that produces real-time assessments of the probability of recession. As an alternative, but complementary, framework we search for non-linear thresholds or "stall speeds." More specifically, when real GDP growth—or some other variable—deteriorates to a given point, do we see the economy's performance weaken sharply further, with a heightened likelihood of recession?

Intuitively, stall speeds might arise for several reasons. *First, when economic performance is already soft, the economy will be more vulnerable*. Certain buffers are in place to help the economy absorb shocks. When those buffers are depleted, adjustment tends to become more pronounced. For firms, a slowing economy will tend to cut into profit margins and cash reserves. Thus, further stresses are more likely to trigger a sharp pullback in spending, investment, and hiring. Similarly, in an environment of slowing economic growth, some households are drawing down their savings and straining to service their debt. And, should further pressures arise, they are likely to sharply pull back on their expenditures. *Second, once the economy has slowed, confidence may be more brittle*. Over and above the depletion of buffers, a slowing of growth may prompt households and firms to preemptively limit their economic vulnerabilities, for example, by cutting spending. Such steps are sensible for each entity on its own, but in the aggregate, these efforts may precipitate economic contraction—exactly the outcome that is feared.

[8] *Another way to summarize these results is that this model points to three states of the world. The first is "normal times" when the probability of recession is near its unconditional mean. The second is "good times" when the probability is a step lower. The third is "vulnerable times" when recession probabilities are higher. In contrast, our other models suggest a two-state world—low risk of recession and high risk of recession.*

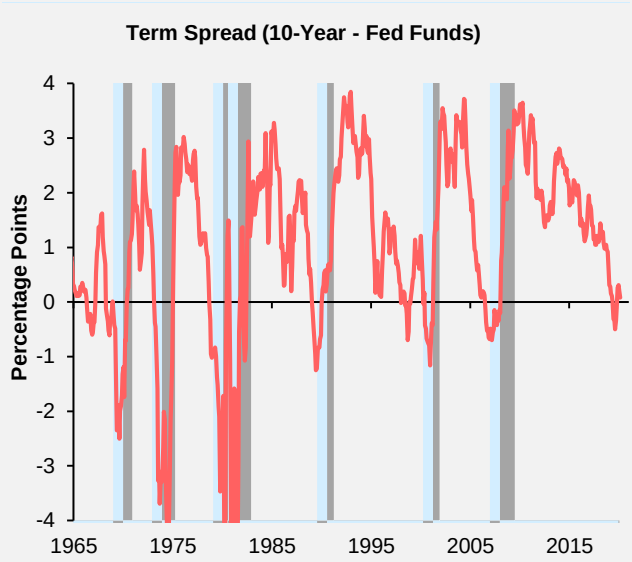
[9] *Statistically, the other three models use the interactions between the variables to gain sufficient confidence to assign very high and very low recession probabilities. The deeper question is whether the data are sufficiently reliable to support such judgments.*

[10] *For the bivariate model, we interpret an estimated recession probability above 30% as signaling recession.*

Box: Has the Yield Curve Lost Its Mojo as a Recession Indicator?

As shown in the previous section, the slope of the U.S. yield curve has been a powerful recession indicator. Conceptually, the front-end of the curve is determined by current Federal Reserve policy and expectations regarding Fed policy. The back of the curve reflects market views about how the economy is likely to perform over long horizons, as well as the appetite for duration risk. Thus, roughly speaking, an inverted yield curve suggests that monetary policy is tight relative to the market's views of the economy's longer-term prospects.

Historically, curve inversions have characterized the periods immediately before recessions. As shown in the chart, this variable has predicted each recession that we study, with lead times ranging from as long as 21 months (1969) to as short as nine months (1973). Further, the curve has generated only two false positives—one in 1966 and another in 1998. (The curve's signal in the summer of 2019 is likely to be another false positive.)



Source: PGIM Fixed Income and Bloomberg

A deeper question is whether an inverted curve not only signals forthcoming recessions, but also causally precipitates recessionary conditions. Specifically, when the curve is inverted, financial intermediation (i.e., borrowing short and lending long) becomes unprofitable. Thus, the inverted curve is likely to weigh on the earnings of banks and other financial institutions while constraining the flow of credit. To the extent that healthy credit provision is an important driver of an expansion, economic growth is likely to be inhibited by an inverted curve.

All that said, the yield curve's apparent false-positive reading from August 2019 highlights a broader debate about whether this variable's forecasting power may have diminished. After all, several extraordinary factors are placing flattening pressure on the long-end of the curve and presumably increasing the likelihood of inversion. First, the Fed and other central banks have significantly enlarged their balance sheets and removed a big slug of duration from the market. Second, regulatory requirements have increased the demand for safe and liquid assets. Third, as a related matter, financial institutions have internalized the lessons from the financial crisis and are managing their balance sheets more conservatively, which has also lifted demand for government securities. Fourth, with the U.S. economy outperforming, rates in Europe and Japan are markedly lower than in the United States. This has intensified the foreign bid for U.S. duration. Fifth, from a longer-term perspective, aging demographics are motivating investors to find relatively safe long-duration assets. All of these factors tend to hold down Treasury yields, particularly those at the back end of the curve.

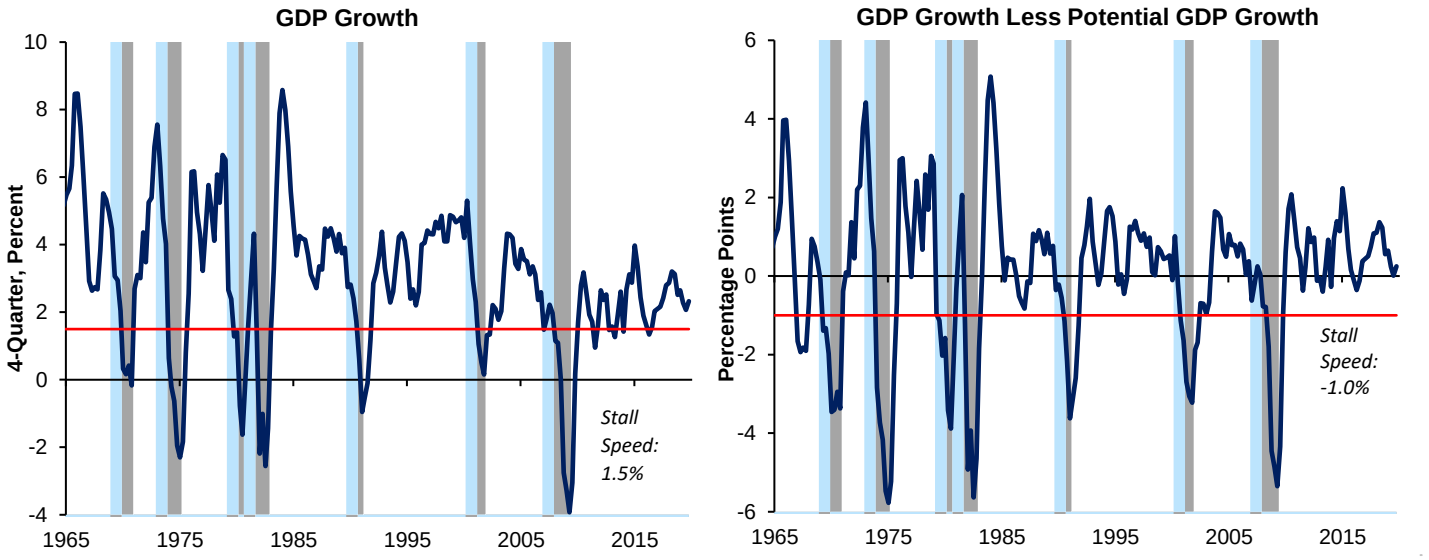
But there may be a deeper issue at work as well. The signaling power of the yield curve has been a focus of much commentary over the past year as markets have looked for signs that the expansion may finally be nearing an end. Thus, as the curve moved toward inversion, both the Fed and the markets were on high alert for recession risks. The Fed's subsequent easing of monetary policy, which helped unwind the inversion, reflected a number of concerns. But our reading is that the signal from the yield curve was an important background factor that prompted the move. More generally, if curve inversion now prompts a pre-emptive easing of monetary policy, the signaling power of the yield curve will be diminished or even reversed.[11] This strikes us as a specific application of a set of insights—variously termed Goodhart's law or the Lucas critique—that once a relationship or an indicator becomes a focus of broad attention, its behavior tends to shift and becomes less reliable.

On balance, we are not inclined to disregard signals from the yield curve entirely, given its strong historical track record. But we do advise interpreting its signals with more caution than otherwise and seeking confirmation from other variables.

[11] *We thank our colleague Mike Lillard for forcefully advocating this point.*

Figure 7 shows one example of a possible stall speed. Until the global financial crisis, when U.S. real GDP growth slowed to less than 1.5-2.0% on a four-quarter basis, it tended to fall sharply further, and the economy entered recession. Notably, however, with the decline in economic growth in the years since the financial crisis, the implied stall speed appears to have declined as well. To address this issue, we look at the behavior of real GDP growth *relative* to the Congressional Budget Office's estimate of potential growth. We find a stable relationship. A decline in four-quarter growth to 1 percentage point (or more) below its potential rate, has reliably been associated with recessions, with only one false positive (more than 50 years ago). Further, like the logit regression models, this simple framework suggests that the economy is a fair distance (a full percentage point) above growth rates that would signal recession.

Figure 7: Stall Speeds for U.S. Real GDP Growth



Source: PGIM Fixed Income, BA, and CBO.

While we see this measure of real GDP growth as a useful recession indicator, it has two drawbacks. First, real GDP is available only on a quarterly basis—and the final reading comes late in the following quarter. Consistent with our previous work in this paper, we prefer indicators that are available more promptly. Second, a careful look at Figure 7 shows that it was late calling the 1973 recession and the global financial crisis and only flagged the 1990 recession one quarter ahead. Thus, we see scope to find stall-speed indicators that are more powerful and timely.[12]

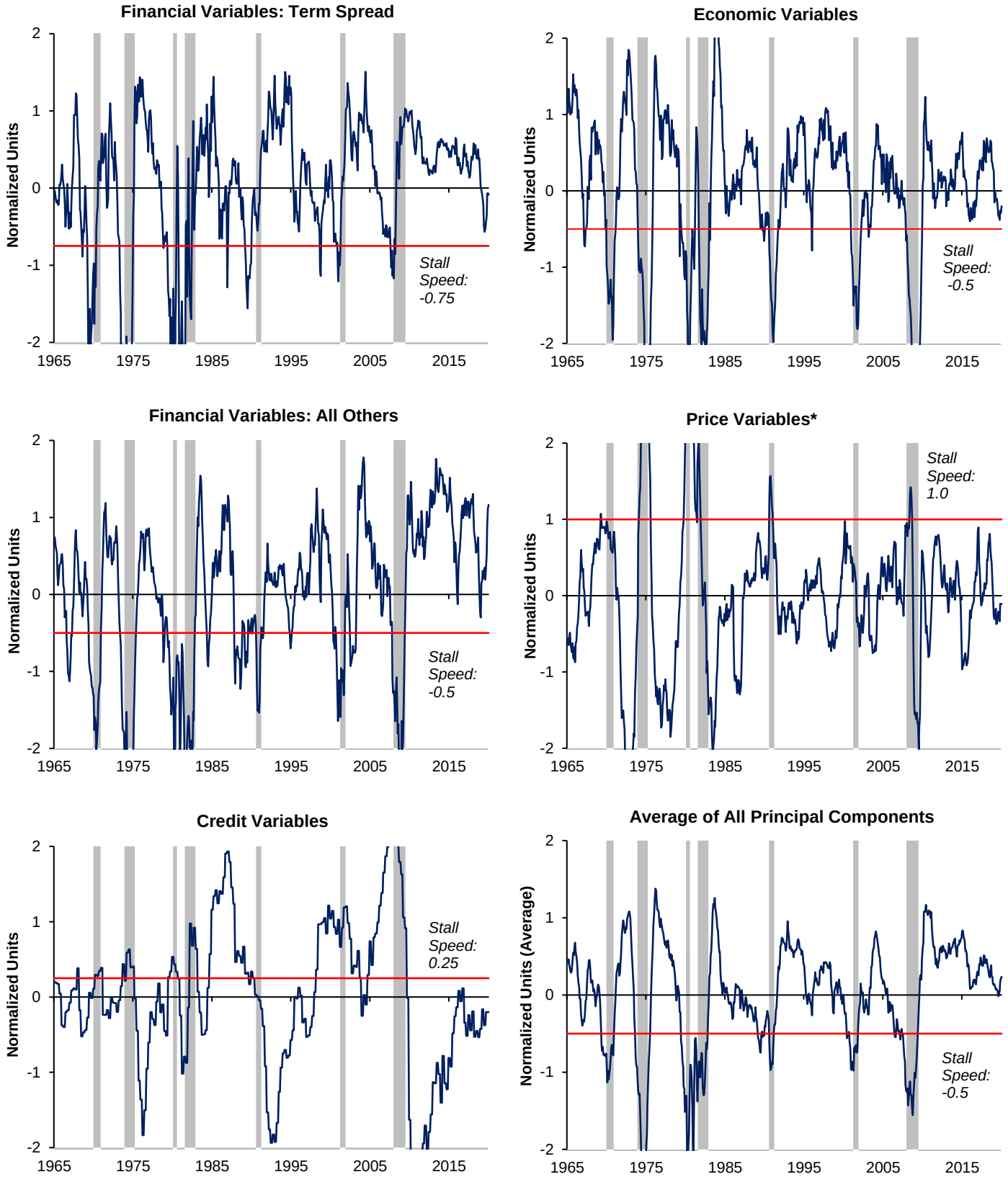
With this in mind, we return to the panel of monthly data shown in Figure 3. To consolidate the data into a manageable number of series, we take the first principal component (PC) of each of the categories. We divide the financial variables into two groups—one that includes the term-spread variables and another for the remaining financial variables.[13] While a range of techniques could be used to identify the stall speeds, we simply draw them in judgmentally, and we assume that the stall-speed is constant across the sample period.

The results of this exercise are graphed in Figure 8. One immediate observation is that the series are not signaling appreciable recession vulnerabilities at present. The credit, price, and other financial variables are all a good distance from their stall speeds. The economic variable is the only one anywhere close to stall speed, reflecting lingering drag from the trade war and the downturn in global manufacturing. (These macro data have yet to reflect the effects of the coronavirus).

[12] *Claudia Sahm has proposed another stall-speed type indicator. She finds that when the three-month moving average of the unemployment rate rises by ½ percentage point relative to its 12-month low, this reliably signals recession. However, this variable lags even more than our measure of real GDP relative to potential. See "Direct Stimulus Payments to Individuals," the Hamilton Project, 2019.*

[13] *Two further comments are necessary. First, in estimating these principal components, we used only the data series that achieved t-statistics of 5 or greater in their bilateral logit regressions. Second, the advantage of using principal components is that it aggregates information from a range of data series. The disadvantage is that the principal components themselves correspond to broad features of the data, rather than to a readily identifiable economic series.*

Figure 8: Stall Speeds of the Principal Components



*Source: PGIM Fixed Income. *Detrended using an HP filter.*

Figure 9 turns to the broader issue of how well these stall-speed indicators signal recession. As before, the financial variables provide an early warning, but at the cost of occasional false positives. In contrast, the price variables are slow to signal, but once a broad-based upturn in inflation occurs, it provides a reliable indicator of recession. The economic variables are also slow to signal, flagging recession more than four months ahead in only two of the cycles.

Notably, the credit variables, which were a poor signal of the first four recessions in our sample, have signaled the last two recessions roughly three years in advance. Perhaps this is an idiosyncratic characteristic of the last cycles, but mounting levels of credit may have become a more useful recession indicator, given the absence of inflationary pressures. Further, credit variables exhibit a high degree of persistence, which may allow them to provide a durable signal of vulnerability. That said, a signal that comes three years in advance creates complexities of its own for investors and markets. At a minimum, it allows policymakers time to implement remedial actions.

Finally, the model derived as the average of all five principal components has performed exceptionally well, particularly during the last three recessions. Its average lead time is 11 months, and it has recorded no false positives. The results from this model are competitive with those from the logit regressions and suggest that it could play a useful role in a dashboard of recession indicators.

Figure 9: Performance of Stall-Speed Indicators (Months Prior to Recession)

	Recession Start						Average	False +
	Jan 70	*Dec 73*	*Feb 80*	*Aug 90*	*Apr 01*	*Jan 08*		
PC Term Spread	17	7	15	17	4	5	11	2
PC Other Financial Variables	7	7	15	33	11	2	13	3
PC Economic Variables	2	-1	10	13	4	1	5	3
PC Price Variables	9	-2	4	0	13	-4	3	0
PC Credit Variables	-3	2	7	--	36	39	16	2*
Average of All PCs	**8**	**3**	**8**	**17**	**10**	**19**	**11**	**0**
*Memo: GDP Growth Less Potential***	*3*	*0*	*4*	*1*	*2*	*-2*	*1*	*1*

*Source: PGIM Fixed Income. *Also one false negative. **The lead/lag is measured in quarters.*

Concluding Thoughts

The evidence we have presented bolsters our confidence that business cycle downturns have some elements of predictability. Every recession has its unique set of drivers and circumstances, but the transmission of those factors through the economy has exhibited notable similarities. Applying these insights to the current expansion, we have found the probability of recession in the United States to be remarkably low. Many of the variables that have historically flagged recession remain at unconcerning levels. Over the past year, the yield curve has signaled some caution, including a full-blown inversion during the third quarter of 2019. But we have also found reasons to question whether the yield curve's salience as a business cycle indicator may have diminished. In sum, the current expansion still seems to be accurately described as "slower but longer"—slower growth than in previous cycles, but longer lived and likely to continue. Of course, the outlook is always subject to many "unknowns" as the outbreak of the coronavirus highlights.

Although data limitations make it difficult to do a similar study for the world economy, the ongoing global expansion shares many features with the U.S. cycle. Most notably, global growth has been softer than in previous episodes, but the expansion has been unusually long lived. Part of this no doubt reflects the important role of the United States, but the similarities strike us as more extensive—and bear the imprint of a common global cycle. First, as in the United States, many central banks around the world have provided their economies exceptional monetary support in an environment with soft inflation and rising indebtedness. Second, the consumer has been the key engine of global growth, supported by strong labor markets, while investment has been relatively muted. Third, like the United States, economies around the world are feeling headwinds from aging demographics. For many developed markets and some emerging markets (such as China and Korea), this means a declining working-age population. These deep drivers have shaped the U.S. cycle and are also clearly at work in the global economy. Further, given that we have found this configuration of factors to be sustainable for the United States (at least for the time being), we conjecture that they are also sustainable globally.

Our work has clear implications for markets. The low probability of recession during the coming year, coupled with a high likelihood that central banks remain stimulative, offers an important green light for risk taking across a broad range of asset classes. In this environment, investors' attention will need to increasingly shift from macro issues (such as recession risks and central bank policies) to more micro issues (particularly the attractiveness of asset valuations). As such, we expect that debates regarding the appropriateness of asset prices will be increasingly front and center in the year ahead.

Appendix

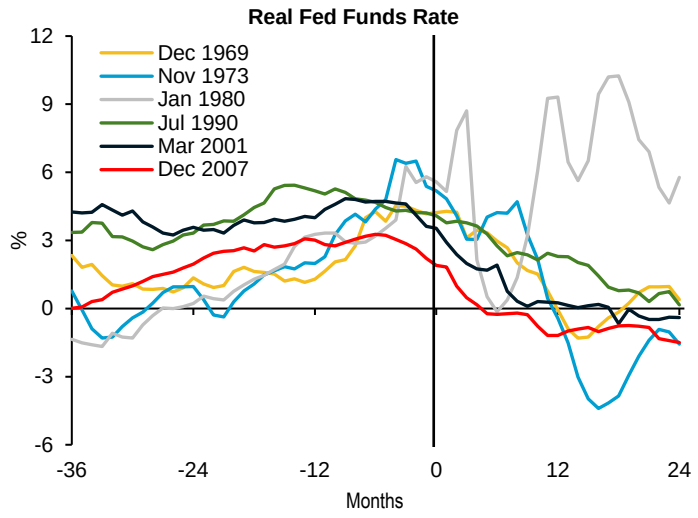
In this appendix, we present underlying data for the four macro series—the real federal funds rate, the term spread, the unemployment rate, and initial claims—that are discussed in Figure 2. These charts are a bit messy, but they nevertheless highlight some common features of the business cycles that we study.

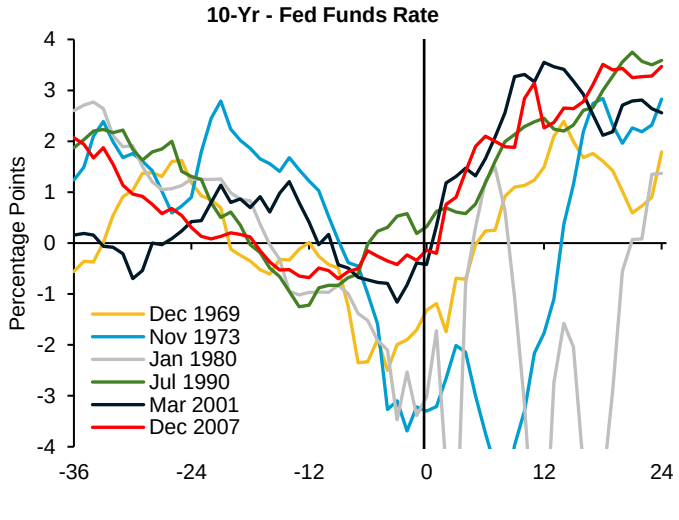
The real federal funds rate. For this series, we emphasize two observations. First, each series saw some hiking of real policy rates during the 24 months or so before the end of the recession. Second, in each instance, the Fed had adjusted policy and the real rate was down from its peak by the time the recession began.

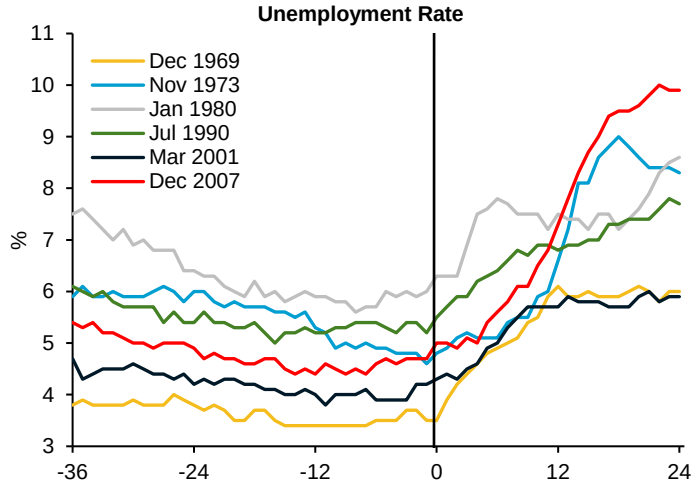
The term spread (10-year - fed funds rate). This measure of the yield curve was inverted at some point during the 12 months before each recession. In every cycle, except for July 1990, the curve remained inverted at the time the recession began. In most cases, however, the curve was less inverted when the recession began than it had been previously.

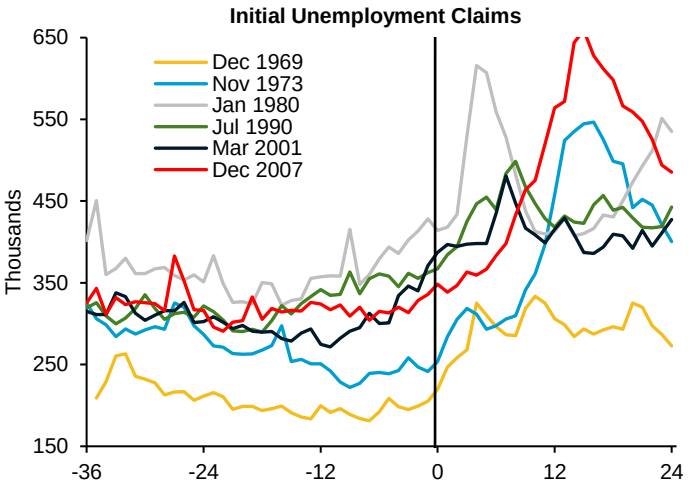
Unemployment rate. The unemployment rate tends to flatten out during the several-year period before the onset of recession. Once the recession begins, the unemployment rate then spikes upward. In this sense, the jobless rate is a lagging indicator—and acts as a signal that a recession has commenced, rather than as an indicator of forthcoming recession.

Initial Unemployment Claims. Initial employment claims are a better leading indicator, with strong signals 12-18 months in advance of recessions in January 1980, July 1990, and March 2001. Claims also moved up before the other three recessions, but the trajectory was somewhat more gentle.









Source: PGIM Fixed Income

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Source(s) of data (unless otherwise noted): PGIM Fixed Income as of February 2020.

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