MACROECONOMIC ADVISERS
By IHS Markit

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What does recent financial turbulence imply for near-term growth?

Turbulence in financial markets has raised concerns about the near-term outlook for real growth. Since early October, credit spreads have widened, implied volatility has spiked, and equity prices have stumbled. Heightened perceptions of risk, as indicated by credit spreads and implied volatility, threaten to slow investment spending, while the hit to equity wealth threatens to soften consumer confidence and, via wealth effects, spending. To quantify and track these risks, we have developed a small "macro-financial" dynamic factor model. This model suggests that financial stresses since early October, if not reversed, will subtract 0.8 percentage point from first-quarter GDP growth, an effect that is already reflected in our base forecast.

The model

The model is a smaller version of the dynamic factor model we use as part of our current-quarter GDP tracking. As a quick review, a dynamic factor model (DFM) is a statistical representation of a panel of data in which each data series is assumed to be a function of a relatively small number of latent common factors and an idiosyncratic error term. The dynamics of the system are captured primarily by the dynamics of the common factors, which are assumed to evolve as a vector autoregression. In our generalization of the canonical DFM, individual data series are allowed to respond to the common factors with a lag, and the idiosyncratic error terms are allowed to follow a moving-average error process.[1]

Our macro-financial DFM (MFDFM) includes six variables, three that measure real output and three that measure financial conditions. The variables measuring output are the IHS Markit PMI for manufacturing output, manufacturing industrial production, and monthly GDP. Industrial production and monthly GDP enter the model as growth rates, while the PMI enters as a level.[2]

We include monthly GDP in the model because it is of primary interest; i.e., we are ultimately interested in how financial conditions impact the near-term outlook for GDP. We include the PMI and IP because they provide early indications of output and, hence, monthly GDP. Indeed, IP for a given month is typically reported two weeks prior to monthly GDP, and the "flash" read on the PMI is typically reported more than one month prior to monthly GDP.[3]

The three variables in the MFDFM measuring financial conditions are the S&P 500, the CBOE market volatility index (VIX), and the spread of Baa-rated corporate bond yields over the 20-year Treasury yield.[4] All three are monthly averages of daily data. The S&P 500 en-

[1] We do not detail the set-up of the model here. Rather, we encourage our readers to review "MA's Second-Generation Dynamic Factor Model," *Macroeconomic Advisers Macro Focus*, 27 June 2018 and "MA's Dynamic Factor Model," *Macroeconomic Advisers Macro Focus*, 18 May 2017.

[2] The level of the PMI measures changes in activity from the prior month.

[3] These three variables work well together as indicators of output, as their first principal component accounts for more than one-half of their total covariance.

[4] These are not the only financial factors that could influence the macroeconomic outlook. Others include the level of risk-free interest rates, the trade-value of the dollar, and bank lending conditions, to name a few. Each of these is included in our quarterly macroeconometric model of the US economy. The variables we include in the MFDFM are indicators of risk, uncertainty, and stress that are available in real time and, as we demonstrate below, are associated with near-term (within three months) movements in output. We experimented with including the trade-value of the dollar but did not find a near-term association with output. We also experimented with the level of the 10-year Treasury yield, but decided this term needed more consideration before its inclusion in the model. Bank lending conditions, unfortunately, are available only quarterly and with a lag.

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Macro-Financial DFM: Estimated Equations

	State Equations		Observation Equations					
	Financial factor	Real factor	Baa Spread	VIX	S&P500	PMI	Mfg IP	Monthly GDP
Financial factor								
Lag 0			0.46	0.60	-0.60	-0.05	-0.15	-0.27
Lag 1	0.33	-0.11	0.20	-0.13		-0.12		0.20
Lag 2		-0.21				-0.04		
Lag 3		-0.20						
Real factor								
Lag 0			0.10	0.27	-0.09	0.26	0.77	0.54
Lag 1		0.15	0.09	-0.07	0.06	0.28	-0.14	-0.18
Lag 2		0.23				0.19	-0.08	-0.12
Lag 3		0.23						
MA(1)			0.16		0.27	0.48		-0.46
MA(2)						0.21		
R^2	0.11	0.55	0.71	0.86	0.80	0.85	0.75	0.50
DW	1.96	2.05	2.00	1.86	1.99	1.95	2.14	2.05

Notes: All equations estimated with ordinal least squares using the first and second principal components "as data." Sample for state equations is May '92 - Oct '18. Sample for Baa, VIX, and S&P equations is Mar '92 - Oct '18. Sample for PMI, IP, and Monthly GDP equations is Apr '92 - Oct '18. All estimated coefficients are significantly different from zero at 1%.

ters the model as a one-month percent change, while the VIX and the credit spread enter the model as one-month changes. We include these three variables because together they nicely summarize financial stress and perceptions of risk, which potentially have wide-reaching implications for the near-term health of the macro economy.[5]

Following the procedure outlined in the Macro Focus pieces cited above, we estimated the state and observation equations, the results of which appear in the nearby table.[6] In this model, the two state equations correspond to the two common factors from the financial and real variables, respectively. A couple of points regarding the state equations are in order. First, the financial factor is essentially exogenous white noise. We say "exogenous" because lags of the real factor do not enter the financial state equation significantly. We say "white noise" because most of the variation in the financial factor is accounted for by the error term (i.e., the r-squared is only 0.11).[7] Second, the real factor is importantly influenced by lags of financial conditions as well as lags of itself. Taken together, these points suggest that, at least over short horizons, causation goes one way: financial shocks quickly feed into the real sector, but conditions in the real sector do not immediately feed back into financial conditions.

[5] These three variables work well together as indicators of financial conditions, as their first principal component accounts for nearly three-quarters of their total covariance.

[6] To summarize, we extracted the first two principal components from the normalized panel of six variables, which together accounted for about two-thirds of the total covariance in the panel. The principal components are consistent estimators of the latent common factors, so we used them "as data" to estimate the parameters of the state and observation equations. The first principal component corresponds to the financial factor because it is highly correlated (> 0.90) with the first principal component of the three financial variables. The second principal component corresponds to the real factor because it is highly correlated (> 0.90) with the first principal component of the three real variables.

[7] When we estimate the state and observations equations, we include terms only when they are significantly different from zero.

Implications of recent financial stresses

To get a sense of the implications of recent financial stresses for the real outlook, we projected this model two different ways. In the first projection, we initialized the model with all data that were available as of November: the PMI and all financials through November, and IP and monthly GDP through October. In this run, the projection of monthly GDP through March yielded a first-quarter annualized growth rate of 1.8%, close to our just issued base forecast of 1.9%. That is, from the perspective of this simple model, our near-term base forecast adequately captures the estimated effects of financial stresses seen through November.

In the second projection, we initialized the model with all available real data, just as in the first projection, but we had the model project financial conditions from October forward. That is, we did not let the model update the financial factor to reflect financial stresses seen in October and November. In this counterfactual run, financial conditions were projected from October forward as favorable, and first-quarter GDP growth was projected at 2.6%. The difference between the first and second projection — 0.8 percentage point — reflects the model's estimate of the marginal impact of the degradation of financial conditions over the last two months.

What would it take to get to zero?

It is encouraging to know that the turbulence in financial markets we've seen so far would reduce growth by less than one percentage point (from 2.6% to 1.8%). That is, a financial shock, if the only source of slowdown, would need to be much larger to drive growth to zero, at least as estimated by this model. But we're not out of the woods yet. At the time of this writing, the S&P 500 (at 2657) was trading about 2% below the November average, and the VIX (at 24) was about 4 points above the November average.

How much worse would December financials need to be to drive first-quarter GDP growth to zero? With some experimentation with this model, we found that a 12% decline in the S&P 500, a 45 basis-point increase in the Baa spread (to 240 basis points), and a 12-point increase in the VIX (to 31) all in December would drive first-quarter GDP growth to zero. Other combinations that would imply the same amount of financial stress (i.e., the same value for the financial factor) would also drive growth to zero. This, of course, puts all of the onus on financials. As is evident from the real state equation, less severe financials in combination with a negative real shock would also suffice .

Concluding Thoughts

Our MFDFM is a convenient way to roughly track the potential impact of current (and recent) financial conditions on the near-term outlook. Because we can track financials in real time, and because financial conditions are predictive for output growth, this will give us an early indication of potential trouble. Late in a given month, with nearly a full month of financials, we will get our first read on output for that month from the "flash" IHS Markit PMI. Then, in the middle of the following month, we get more information for the month from manufacturing IP along with more current financials. And finally, about two weeks later, we'll get a read on monthly GDP. The MFDFM will update the projection for GDP at every stage, incorporating marginal information from each of the financial and real indicators. If output growth is about to turn negative as a result of a financial shock, the MFDFM will likely give us the first indication.

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