PMI commentary

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United States

Investigating IHS Markit PMI[™] and ISM divergences

- Analysis suggests ISM data overstated manufacturing growth in much of 2017 and 2018, while December plunge appears to be a false signal
- ISM overestimation of growth potentially linked to panel bias towards large companies
- Equity market rally and stronger global growth likely provided boost to ISM data in 2017 and 2018

Official data indicated that factory production rose solidly in December, rounding off a robust fourth quarter. Output jumped 1.1% during the month according to the Fed's data, rounding off a fourth quarter during which production rose 0.6% compared with the third quarter. The fourth quarter expansion was nevertheless below the 0.9% increase registered in the third quarter, hinting at a moderation in the underlying pace of factory growth.

The official data therefore confirmed the picture of robust but moderating growth as shown by earlier IHS Markit Manufacturing PMI[™] data, flash results for which will provide insight into January's performance when published this week.

The release of the official data for December also help to clarify recent confusion over differing survey signals: the relatively robust pace of expansion signalled by the IHS Markit survey contrasted with a far more abrupt slowdown indicated by the ISM survey.

With the plunge in the ISM index having sent a misleading signal of the health of the goods-producing sector, we look at the relationship between the two surveys and the official data, and find that the divergences likely reflect a difference in survey panel structure, and specifically a tendency for the ISM data to be more influenced by global economic growth and foreign earnings than the IHS Markit PMI.

Survey divergence

Differing survey signals were seen at the end of 2018. The headline index from the IHS Markit Manufacturing PMI registered 53.8 in December, down 1.5 points from 55.3 in November. By comparison, the headline index from the ISM manufacturing survey fell more sharply, down from 59.3 in November to 54.1, a drop of 5.2 points. The decline left the ISM index some 5.1 points below the average seen in the prior 11 months.

While the IHS Markit survey therefore suggests that the manufacturing sector saw moderating but still solid growth, the ISM index suggests that the pace of growth cooled much more sharply from booming rates in prior months.



Chart 2: ISM v IHS Markit Manufacturing PMI output









Exaggerated growth in prior years

In seeking to ascertain which survey has been sending the correct signals, we need to dig deeper into the survey subindices rather than analysing the headline numbers. The headline manufacturing PMIs from the two surveys are composite indicators derived from five individual survey questions relating to output, new orders, employment, inventories and suppliers' delivery times. It is the first two of these questions which have shown the greatest divergence.

While the headline indexes from the two surveys can vary due to differences in calculation (the ISM uses a straight average of its five component series whereas the IHS Markit series uses a weighting system such that forward-looking components carry a higher weight), the contributing indexes such as output and new orders should be directly comparable.

In theory therefore, the ISM and IHS Markit sub-indices should follow similar trends. All sub-indices are diffusion indexes which vary around 50, the level which indicates no change on the prior month. The indices are simple calculations based on the number of companies that have reported an improvement, deterioration or no change in the survey variable being monitored.

Charting these directly-comparable survey indicators side-byside (see charts 2 and 3) further highlights the divergences, with ISM output and new orders data running considerably higher than the IHS Markit indices through 2017 and 2018.

Statistical analysis meanwhile indicates that the IHS Markit indices have a stronger relationship with official output and order book data than the equivalent ISM indices. Looking at the period mid-2007 to late-2018, for which both ISM and IHS Markit manufacturing PMI data are available, the IHS Markit data show consistently higher correlation coefficients and adjusted r-squares than the ISM data (see table 1).

Implied growth rates derived from the regressions are shown in charts 4 and 5, and indicate the exaggerated growth signals from the ISM surveys over much of the past two years. Prior to December, these estimates signal that the ISM index has overstated actual output growth in 24 of the past 28 months. In December, however, the analysis indicates that the ISM indices pointed to a fall in both output and factory orders.

Table 1: statistical analysis of surveys with official data

	IHS Markit PMI	ISM	
Manufacturing output (3m/3m % change)		
Correlation	0.89	0.81	
Adjusted r-square	0.79	0.64	
Manufacturing employment (monthly ch Correlation Adjusted r-square	ange) 0.91 0.84	0.78 0.70	
Factory orders (3m/3m % change)			
Correlation	0.76	0.72	
Adjusted r-square	0.57	0.51	
Durable goods orders (3m/3m % change)			
Correlation	0.76	0.65	
Adjusted r-square	0.58	0.42	

Note: Comparisons use monthly data from June 2007 to October 2018.

Chart 4: Manufacturing output

Output, 3m/3m % change



Note: chart shows ISM and IHS Markit implied manufacturing output growth rates derived from regression analysis with the survey output index acting as explanatory variable of the three-month-on-three-month rate of change in the official data. Sources: IHS Markit, ISM, Federal Reserve.

Chart 5: Factory orders



Note: chart shows ISM and IHS Markit implied orders growth rates derived from regression analysis with the survey new orders index acting as explanatory variable of the threemonth-on-three-month rate of change in the official data.

Sources: IHS Markit, ISM, Federal Reserve.



Relationship breakdown

It therefore appears that the relationship between the ISM survey and official manufacturing data has changed. A <u>recent</u> <u>paper</u> from economists at Macroeconomic Advisers uses further statistical analysis to demonstrate that the ISM output and new orders indexes have overstated growth of their official corresponding economic concepts to the extent that a statistical break in the relationships likely occurred in mid-2017. The analysis found that no such statistical break is evident in the IHS Markit survey.

Does company size matter?

There are of course several potential causes of potential variation between the two surveys which may help explain why the ISM numbers have differed so markedly from the official data and IHS Markit survey over the past two years, outlined more fully in appendix 1. However, evidence suggests that the divergence is most likely due to the exclusion of smaller companies in the ISM panel. This theory is given some weight by the analysis of IHS Markit data by company size, which shows larger companies to have reported considerably faster rates of growth of output and new orders than smaller firms over the past two years.

While it is not uncommon for large firms to outperform smaller companies in the IHS Markit surveys, it is noteworthy that particularly strong output growth has been recorded by larger firms in recent months, albeit with growth slipping sharply in December (matching the decline seen in the ISM index). Charting the IHS Markit larger companies output index alongside the ISM and official data further illustrates this closer correlation (see chart 7).

Chart 6 outlines the composition structure of the IHS Markit manufacturing PMI panel of just under 800 companies, illustrating the true structure of industry by sector contribution to total manufacturing value added and by firm size. This structure is also used to weight the survey responses to ensure sector and company size characteristics carry suitable influence in the overall survey results. Equivalent information is not available from the ISM.



Chart 6: IHS Markit Manufacturing PMI panel structure

Sources: IHS Markit, BEA national accounts, Census Bureau.





Chart 8: IHS Markit manufacturing output by firm size IHS Markit PMI Output Index



Chart 9: IHS Markit manufacturing orders by firm size

IHS Markit PMI New Orders Index



Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Source: IHS Markit



Survey responses and non-US growth

The outperformance of the ISM index over the past two years due to a bias toward large companies may also be a function of the survey data reflecting business trends outside of the US, and not just the domestic market. Larger multi-national firms may be unable (or unwilling) to separate out domestic US performance in their survey replies. In this respect, it is interesting to note that manufacturing growth outside of the US accelerated markedly at the same time that the statistical break between the ISM and the official US manufacturing output data is observed.

According to IHS Markit's global PMI database, global manufacturing output and new orders growth excluding the US accelerated from near-stagnation in mid-2016 to reach three-year highs in March 2017. Robust growth was then sustained until the fall of 2018.

Similarly, official data on manufacturing output (aggregated from national statistical offices) showed the annual rate of growth of production worldwide excluding the US more or less doubling in the year to mid-2017.

The PMI and official data for global factory output excluding the US are shown in chart 10 with comparisons of ISM and IHS Markit US manufacturing output included in charts 11 and 12. While both surveys are correlated with global goods production outside of the US, the ISM clearly has a closer fit in recent years.

The closeness of fit in fact helps to explain the divergence of the ISM data with the official data: the extent to which the ISM data have over- or -understated annual manufacturing output growth over the past 20 years has an 82% correlation against global goods production outside of the US, with the ISM data acting with a lead of three months.



Chart 10: Global factory output excluding the US





Chart 12: IHS Markit vs global ex-US factory output



Chart 13: Global ex-US factory output and ISM over/ understatement of official manufacturing output growth





Survey responses and equity prices

There is some evidence to suggest that the strength of the ISM index over the past two years may be linked to equity market performance. Such a link may also be related to any survey bias towards large companies: if share prices for large manufacturers are rising (or historically high), survey respondents may be more inclined to report positive survey responses and vice versa. The link to share prices may also be correlated with global rather than domestic US sales, adding weight to the hypothesis that the misleading strength of the ISM survey over the past two years may reflect multinational businesses performance rather than purely US business trends. We note that almost 44% of earnings at S&P 500 companies are estimated to come from foreign countries.

To test this theory, we compare the ISM and IHS Markit manufacturing output indices against the S&P 500, more specifically comparing survey values against the change in equity prices in the current month relative to the trailing sixmonth average to gauge how changing stock market momentum might correlate with business reporting.

The comparisons indicate that the ISM index is more closely correlated with changing share price performance than the IHS Markit index, and that it is share prices in the current reporting month and the immediately-prior month that have the highest correlations, as would be expected (see Table 2). Chart 14 illustrates the closer fit of the ISM index with equity prices compared to the equivalent IHS Markit index, shown in Chart 15.

There is also some evidence to indicate that equity price movements are correlated with the extent to which the ISM index has overstated manufacturing output growth. Chart 16 compares equity price momentum (current month relative to the prior six months' average) with the gap between the official output data and implied ISM growth rate derived from chart 4. With the principal exception of the 2008-09 financial crisis, major changes in equity prices have often been accompanied by the ISM index over- or understating actual output growth, with a notably higher (60%) correlation seen since mid-2015.

Table 2: Correlations with equity prices (2007-2018)

	ISM output index	IHS Markit output index
S&P 500		
Equity prices lagging by 1 month	0.63	0.45
Coincident	0.72	0.56
Equity prices leading by 1 month	0.75	0.63
Equity prices leading by 2 months	0.71	0.67
Equity prices leading by 3 months	0.64	0.67





Chart 15: IHS Markit output index vs equity market



Chart 16: Share price growth and ISM over/ understatement of official manufacturing output growth





Survey responses and energy prices

We have also seen reports which speculate that oil prices and energy sector activity affect the ISM data, which could have led to the exaggerated ISM readings since 2016. This could potentially be the result of the ISM panel being biased in some way towards manufacturing companies with strong exposure to energy sector investment spending.

Looking first at oil prices, using WTI data to track price momentum (i.e. the current month's price relative to the trailing six-month average), there is a clear correlation between prices and both survey indices, albeit with some periods (notably 2014) when the relationship breaks down, as shown in Charts 17 and 18.

The ISM output index exhibits a higher degree of correlation than the equivalent IHS Markit index, although both statistical relationships are relatively weak. Oil price momentum shows a 0.54 correlation with the ISM index with a one-month lead for oil prices, while the correlation drops to 0.47 for the IHS Markit index (also with a one-month lead), suggesting that changing oil prices have a closer relationship with the ISM data than the IHS Markit survey.

Table 3: Correlations with energy prices (2007–2018)

	ISM output index	IHS Markit output index
Oil price lagging by 1 month	0.35	0.31
Coincident	0.48	0.41
Oil price leading by 1 month	0.54	0.47
Oil price leading by 2 months	0.53	0.46
Oil price leading by 3 months	0.44	0.41

There are clear signs from the comparisons that the changing oil price can be associated with periods for which the ISM data has over- or under-stated the official manufacturing output numbers, but there are notable periods where the relationship breaks down, principally though the global financial crisis years of 2008–09 and 2014–15. Chart 19 plots the oil price momentum data against the ISM output index and provides some evidence to suggest that some of the strength of the ISM data over the past two years could be related to the high oil price, with the implication that the ISM data has further to fall in coming months.

Chart 17: ISM output index vs oil prices



Chart 18: IHS Markit output index vs oil prices



Chart 19: Oil prices and ISM over/understatement of official manufacturing output growth





Survey responses and energy sector activity

Looking at how energy sector activity may affect the survey data, and could potentially have led to the exaggerated ISM readings since 2016, we use crude oil and gas rig turnover data as a proxy, using the current month's activity relative to the trailing six-month average as a guide to changing growth momentum.

Statistical analysis indicates that both the ISM and IHS Markit output indices are similarly correlated with energy sector activity, with the closest fits observed when the survey data act with advance leads on the energy sector. The ISM data are marginally more closely correlated than the IHS Markit data, though both show periods of poor correlation between 2014 and 2015, which is commensurate with weak fits with official manufacturing output data in this period.

Table 4: Correlations with rig turnover (2007–2018)

	ISM output index	IHS Markit output index
Rig turnover lagging by 4 months	0.59	0.57
Rig turnover lagging by 3 months	0.65	0.62
Rig turnover lagging by 2 months	0.64	0.64
Rig turnover lagging by 1 month	0.59	0.60
Coincident	0.52	0.54
Rig turnover leading by 1 month	0.40	0.46

Of note, the period of over-estimation of the official data by the ISM since 2016 corresponds with a period of generally robust energy sector activity growth. However, there is on the whole a weak observed link between energy sector activity and the over/understatement of the official output growth by the ISM index.

Chart 20: ISM output index vs rig turnover



Chart 21: IHS Markit output index vs rig turnover



Chart 22: Rig turnover and ISM over/understatement of official manufacturing output growth



2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018



Modelling ISM errors

A regression can be used to model the extent to which the signal from the ISM manufacturing output index diverges from the official three-month-on-three-month growth rate, using the four variables discussed above for which there is some evidence of correlation, namely annual global ex-US manufacturing output growth (lagged by three months), the change in the S&P500 against the prior six-month average, the change in WTI oil prices relative to the prior six month average, and the change in US energy turnover relative to the prior six month average.

The results shown below in table 5 indicate that the regression produces an adjusted r-square of 0.74, with global manufacturing growth excluding the US having by far the greatest importance in modelling the error, followed by the S&P500. Oil prices and energy sector variable coefficients, on the other hand, and not statistically significant.

The modelled divergence produced by the regression is depicted in Chart 23 against the actual over/understatement of official manufacturing output data by the ISM index. While not all of the recent over-statement of the official data by the ISM is captured by the model, the overstatement trend over the past two years is clearly captured. It should also be borne in mind that the most recent official data are still subject to revision.

Table 5: Regression of ISM over/understatement of official manufacturing output growth

Variable	Coefficients	Standard Error	t Stat
Constant	-0.845	0.073	-11.628
Global ex-US manufactu	0.271	0.014	19.207
S&P 500	0.003	0.001	4.852
Oil prices	0.006	0.005	1.165
Energy sector turnover	0.005	0.008	0.559

Chart 23: Modelling ISM over/understatement of official manufacturing output growth



Appendix 1

Potential causes of survey divergence

The surveys are based on responses from different companies: IHS Markit and ISM approach different companies to participate in their surveys so the results naturally reflect business conditions at different companies. The intention is of course that the surveys accurately reflect the true structure of the economy, and both survey structures are designed to accurately reflect the correct sub-sector contributions to GDP, but any discrepancies from these targets can cause misleading signals to be sent.

Survey panel sizes are different: IHS Markit's survey panels are larger than the ISM's stated panel sizes. In manufacturing, IHS Markit surveys just under 800 manufacturing companies (approximately double the size of the ISM panel size) from which an 80% response rate is typically received. However, unlike IHS Markit, ISM does not disclose actual numbers of questionnaires received. As a general rule, a large panel size produces more stable and accurate survey results, and also enables a breakdown of the data by sector and company size.

Survey respondent bases are different in terms of company size: ISM data are based only on ISM members and as such are likely to only reflect business conditions in larger companies, with small- and medium-sized firms under-represented. In contrast, IHS Markit's surveys include companies of all sizes (see chart 6). In addition to weighting responses according to the relative size of each sub-sector of manufacturing, IHS Markit also incorporates appropriate weights for company size, meaning large firms have a relatively greater influence on the results.

Survey respondent bases are different in terms of job function: IHS Markit surveys extend to other job functions while we understand that ISM data are based purely on purchasing and supply professionals. Note that many smaller firms do not have a purchasing manager.

Seasonal adjustment methods differ: the surveys use different methods of seasonal adjustment which may mean intra-year variations can become apparent (though this should not affect annual averages).



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