The Information Content of the ISM Purchasing Managers' Survey

Daniel Bachman

U.S. Department of Commerce*

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1. Introduction

At the beginning of every month, the business press focuses briefly on the survey published by the Institute for Supply Management (ISM). Press descriptions—and the ISM itself—describe the survey as providing information about the state of U.S. manufacturing. Press reports in recent years have therefore tended to conflate the ISM with the manufacturing sector. For example, an Associated Press (AP) article on September 3, 2008, described a decline in the ISM composite index this way: "the latest economic indicators, released on Tuesday, showed that manufacturing shrank in August."

Researchers do not use the ISM survey as a fundamental measure of manufacturing activity, however. Instead, they turn to official government data series such as the Federal Reserve's industrial production index or the Census Bureau's Manufacturing Shipments, Inventories, and Orders survey. Most analysts believe that these series are more comprehensive and have more scientifically accurate samples and methdologies than the ISM, and therefore better measure actual economic activity. The main value of the ISM survey is rather in its anticipation of later official data, because it is published significantly

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* The views in this paper are those of the author alone, and do not reflect official opinions of the U.S. Commerce Department.

earlier than the official data. For both private economic actors and public policymakers, there is value in learning something about the state of the manufacturing sector two to four weeks before the first official measures are published.

The September 2008 experience provides an interesting example of the difference between these two uses of data. In the release that is the subject of the AP article quoted above, the ISM index fell slightly (from 50.0 in July to 49.9) in August—but it was noteworthy that the index was below 50. Hence the AP's suggestion that "manufacturing shrank" (a number below 50 indicating that more than half of the respondents believed that activity was lower in September than in the previous month). In contrast, the Federal Reserve's measure of manufacturing industrial production—released two weeks later—dropped by a very substantial 1.0% over the same period. Today, most students of the business cycle would accept as a given that manufacturing production fell substantially in August 2008, based on the Federal Reserve measure. I am not aware of any analysts who would find additional information in the ISM composite index for this series.

In this paper, I test and measure what the manufacturing ISM has told us in the past about the actual state of manufacturing as measured by official data. I base my tests on the improvement in short-term forecasts of official data when ISM survey information is included in the forecasting equation. Previous research either used the ISM survey to predict GDP—rather than manufacturing activity—or looked at correlations of one published element of the ISM survey—the ISM composite index—and industrial production. In contrast, I report on a simulation of the experience an actual user might have had she incorporated the ISM survey data into her forecasts. I also use the individual indexes published by the ISM to predict specific related official government data series such as manufacturing inventories and producer prices. This allows me to draw conclusions about the accuracy of specific questions of the ISM survey.

The ISM also collects and publishes a survey of nonmanufacturing firms. In this paper, however, I focus exclusively on the ISM manufacturing survey.

2. The ISM Survey and the PMI

The ISM manufacturing survey is one of the most venerable private sector measures of economic activity. The original survey by the Purchasing Management Association (now called the Institute for Supply Management) dates back to 1931, although consistent data is only available from 1948. The ISM currently reports on the results of questions in ten areas. (see Table 1). It also publishes a composite of five of the indexes called the "Purchasing Managers Index" (PMI) which is normally the subject of media reports.

Table 1 lists the twelve ISM indexes (eleven on specific topics and the PMI index,

Table 1: ISM indexes and corresponding official data series

ISM index	**Official data series and source**
Purchasing Managers Composite	Industrial production (Fed)
Production	Industrial production (Fed), manufacturing shipments (Census M3)
Employment	Payroll employment in manufacturing (BLS)
New Orders	Manufacturing new orders (Census M3)
Supplier Deliveries	N/A
Backlog	Manufacturing unfilled orders (Census M3)
Inventories	Manufacturing inventories (Census M3)
Customers' Inventories	
Prices	Producer prices for finished goods (BLS)
New Export Orders	Real merchandise exports (Census FT)
Imports	Real merchandise imports (Census FT)
Buying Policy	N/A

Note: N/A means that there is nobvious official data corresponding to the ISM's question.
Sources: Fed=Federal Reserve Board, Census M3=Census Bureau Manufacturing Shipments, Inventories and Orders, BLS=Bureau of Labor Statistics,Census FT=Census Bureau Foreign Trade.

which is a composite of five of the ISM indexes). The table also shows related "fundamental" official series. Note that there are two possible official series related to the production concept—the Federal Reserve's industrial production in manufacturing, and the Census Bureau's manufacturing shipments.

In most cases, the indexes ask about activity during the same period covered by the data. The relationship between the ISM export new orders and real exports, however, may be looser than the other relationships posited in the table. For exports, the ISM asks about *orders* in a particular month, which could well turn into actual export flows as measured by the Census Bureau's monthly trade data with a lag of several months.

ISM data is reported as the percentage of positive responses, so a value of 50 for the production index means that half of respondents increased production in the reporting month, and half decreased production. (No change responses are proportionately allocated.) The ISM survey reaches about 300 members of the Institute, and responses are weighted by NAICS industry.

3. Past Research

The prominence of the ISM index has led to a considerable literature discussing the relationship between it and official measures of economic activity. Since 2000, a number of articles have found some relationship between the PMI index and measures of overall economic activity.

Roland F. Pelaez [2002] examined the ability of the PMI index to forecast GDP. Pelaez compared a forecasting model using the PMI (essentially constraining the weights of the subindexes in the forecast) to a model in which the five subindexes in the PMI are used to directly forecast GDP (which amounts to removing the constraints). Palaez found that an index consisting of just three subindexes—new orders, employment, and supplier deliveries—outperformed the standard ISM index in forecasting GDP.

M. Harris, R. Owens, and P.D. Sarte [2004] found that the ISM "is effective in tracking movements of GDP in real time (i.e., considerably ahead of the GDP release). They calculated that the ISM index improves the current quarter forecast of GDP by about 12%, and the one-quarter-ahead forecast of GDP by 31%. They also argue that "the ISM and its individual components generally represent a reliable, albeit imperfect, signal of future recessions." In a related paper, R. Owens and P.D. Sarte [2005] use spectral techniques to answer similar questions. They concluded that diffusion indexes including the ISM index show business-cycle length frequencies, which supports the view that "monetary policymakers can use the information to better shape policy." Owens and Sarte argue against the view that surveys such as this one are fundamentally flawed: "while surveys allow for much discretion in the way respondents answer questions, this discretion does not obscure the informational content of the responses in such a way as to simply produce statistical noise."

Timothy Schiller and Michael Trebing [2003] compare forecasts of industrial production using the PMI, the ISM manufacturing index, and a variety of other variables and related models. They claim that "by themselves, the diffusion indexes from the ISM survey 'explain' 29 to 36 percent of the month-to-month variabion of the monthly changes in the IP-M [monthly industrial production index].". Shiller and Trebing note that adding diffusion indexes to other predictive series, such as hours worked in manufacturing, "can increase the accuracy of a forecast." They appear to measure accuracy here by R^2, since they report neither forecasts nor any measure of forecast error.

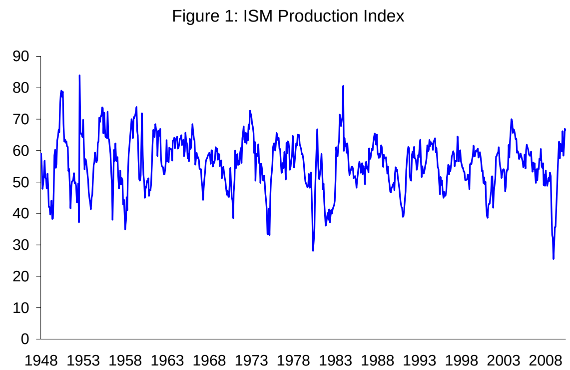
Evan F. Koenig [2002] ran a regression of the PMI on industrial production. He concluded that "factory output depends about equally on the level of the PMI and the PMI's most recent change." He based this statement on the significant t-statistics for both coefficients. Mr. Koenig also tested to see whether the PMI has predictive power by calculating real-time forecasting regressions for GDP using employment, retail sales, and industrial production along with PMI, and found that, even with the other variables, the PMI has "marginal predictive power." It seems a bit odd that the PMI index would have explanatory power for GDP beyond that provided by the Industrial Production Index. However, the PMI subindexes do include some information (such as orders, inventories, and export orders) which are not part of the official industrial production measure.

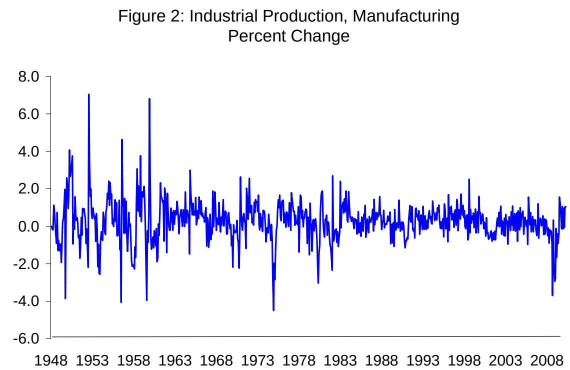
4. Tests

4.1 Characteristics of the data

Figure 1 shows the ISM production index since 1948. The mean value of the index, 55.7, indicates that, on average, more firms experience growth than falling production. That is consistent with the simple fact that, over the long term, the economy experiences growth. There is no suggestion here that the level of the ISM series changes over time. The other ISM indexes have similar properties.

The ISM index is designed to measure the level of change in the underlying variable (i.e., the change in production, employment, inventories, etc.). Thus it makes sense to measure the corresponding official series—most of which are published in level form—as





rates of change. Figure 2 shows the percentage change in manufacturing IP, the variable that the ISM production index should be able to predict. Note that the rate of change appears stationary. Thus, is unlikely that cointegration exists—and that a unit root would pose problems for estimation and testing. Nevetheless, I calculated Dickey Fuller tests and augmented Dickey Fuller tests for unit roots. In all cases, the hypothesis that the series as used here have a unit root can be rejected with a high degree of certainty.

4.2 Testing strategy

Formally, we can think of two series, written here in stationary form:

(1)
$$\begin{aligned} x_t &= a_x x_{t-1} + \varepsilon_t + \eta_{xt} \\ y_t &= a_x y_{t-1} + \varepsilon_t + \eta_{yt} \end{aligned}$$

where 0<a<1, the η terms are idiosyncratic shocks unique to the respective processes, and ε is a shock common to both processes. Early in the month, we know the current period value of y, but not of x. Clearly we should be able to use the information in y to obtain a better prediction of x than we would obtain knowing only past information (defined here as past values of x.

The key question for a typical data user is whether the ISM index helps to forecast the subsequent official data. Consider the following two forecast equations, where x is the official government measure and y is the related ISM index:

(2)
$$x_t = C + \sum_{t=1}^{n} A_t x_{t-1} + \varepsilon_t$$
$$x_t = C + \sum_{t=1}^{n} A_t x_{t-1} + By_t + \varepsilon_t$$

The first equation in (2) projects x based on past values of itself. The second equation adds the contemporaneous ISM index, since it is known before x. A simple test of the information content of the ISM index is that adding it to the forecasting equation will result in improved forecasts of the current value of x, or essentially, whether the model in equation (1) is correct.

4.3 Forecast Improvement

I estimated forecasts from the equations in (2) for each pair of ISM indexes and official measures. I estimated each equation on a rolling basis, using ten years of past history. I started the forecasts in January, 1998 and ran them through December, 2009. After estimating the equation for each ending period, I then calculated the projection from the equation for the economic measure in the next period, based on the actual value of the ISM indicator. I therefore created 12 years (144 observations) of predicted one-period ahead forecasts for the official series.

. The process in effect simulates the experience a forecaster might have in using the ISM term to predict the subsequent economic indicator for each month. However, I used revised and not vintage data for this experiment.

Table 2: **Forecast Improvement**
Percent improvement over forecast without ISM measure

Economic Measure	ISM Index	MAE	MSE
Industrial Production	PMI Composite	**9.0**	**8.7**
Industrial Production	Production	**11.0**	**11.8**
Manufacturing Shipments	Production	2.4	7.8
Payroll employment, manufacturing	Employment	0.0	5.4
Manufacturing new orders	New orders	**5.0**	6.7
Manufacturing unfilled orders	Backlog	1.0	0.6
Manufacturing inventories	Inventories	0.3	**1.2**
Producer prices for finished goods	Prices	**9.1**	**11.3**
Real merchandise exports	Exports	**7.4**	**7.0**
Real merchandise imports	Imports	5.0	**5.9**

Note: bold indicates the improvement is significant at the 5% level according to the Diebold-Mariano Test.

Table 2 shows the percent improvement in the forecast for the 10-year period when the ISM indicator is included in the forecasting equation. The table shows two metrics: the mean absolute error (MAE) and the mean squared error (MSE). For example, the average forecast error of the Federal Reserve's manufacturing industrial production index was 11% smaller when the ISM production index was included in the forecasting equation. This essentially measures what a practical user of the data would want to know: it answers the question, "how much does the ISM index help forecast relevant official data." Although I've included an indication of the results of significance tests, the reader should be wary of reading too much into them. The 5% confidence limit is arbitrary and likely does not represent the actual loss function faced by forecasters. I suspect that a large improvement in forecasting power which was significant at the 30% level might be of great interest to financial market participants, while a 5% improvement that is significant might not be of much use to analysts. (See Stephen T. Ziliak and Deirdre N. McCloskey (2007) for a complete polemic on this point.)

It would be hard to characterize the improvements in Table 2 as "large." The best improvement comes in forecasting industrial production and that just over 10%. There is a similar improvement in the forecast of producer prices. On the other hand, there is less improvement in forecasting employment or the various components of the Census Bureau's manufacturing shipments, orders, and inventories (M3) survey. These series (shipments, new orders, unfilled orders, and inventories) are all nominal, so it is certainly possible that the additional variation in price in the target series has reduced the forecasting ability of the ISM survey index.

A further interesting feature of Table 2 is that the forecast improvements tend to be larger when the forecast error is measured by mean squared error. This suggests that the ISM indexes are most useful at times when past values of the official series are most misleading—perhaps during turning points, for example, if (as seems likely) errors in the univariate time series model are largest at turning point..

Nevertheless, the results in Table 2 suggest that the information in the ISM indexes provides at best a modest improvement over a univariate forecast. This is particularly striking since the univariate forecast is likely a relatively weak competitor. Structural forecasting equations for each of these series based on economic theory are very likely to be more accurate than the univariate forecast, which might well reduce or eliminate the usefulness of the information in the ISM indexes.

4.4 Forecast Performance in the 1960s and 1970s

The structure of the U.S. economy and the U.S. manufacturing sector has changed substantially over time. The ISM series might have contained more, different, or less

Table 3: **Forecast Improvement in the 1960s and 1970s**
Percent improvement over forecast without ISM measure

Economic Measure	ISM Index	MAE	MSE
	(Forecast Period: 1960-1969)		
Industrial Production	PMI Composite	**15.5**	**17.9**
Industrial Production	Production	**11.9**	16.2
Payroll employment, manufacturing	Employment	**18.0**	**15.8**
Producer prices for finished goods	Prices	1.4	1.1
	(Forecast Period: 1970-1979)		
Industrial Production	ISM Composite	**7.8**	10.0
Industrial Production	Production	**14.2**	**13.5**
Manufacturing Shipments	Production	2.8	6.2
Payroll employment, manufacturing	Employment	**9.2**	17.7
Manufacturing new orders	New orders	**11.8**	**11.7**
Manufacturing inventories	Inventories	**6.3**	**5.5**
Producer prices for finished goods	Prices	5.4	4.7

Note: bold indicates the improvement is significant at the 5% level according to the Diebold-Mariano Test.

information in the past, even though the relationship is no longer as strong today. Table 3 shows the results of running a forecasting exercise like the one described above for data during the 1960s and 1970s.

It was impossible to forecast the full set of economic series because some of these series do not exist during this period. The Census M3 series start in 1958, so there are not enough observations to estimate forecast equations for the shipments, new orders, unfilled orders, and inventories series for the 1960s. Census publishes real imports and exports series currently starting only in 1994, and the ISM survey question on unfilled orders starts in 1993, so it is impossible to create forecasting equations for the trade series or unfilled orders in either the 1960s or the 1970s.

The ISM survey indexes improved forecasts of the official series slightly more during the 1960s and 1970s than during the 1998-2009 period. The improved ability in forecasting the Census M3 series, such as new orders and inventories, in the earlier period is particularly striking. These series are nominal values, while the ISM series are best interpreted as real series. Thus, the 1970s, a period of high and variable inflation, should have seen a deterioration in the forecasting ability of the ISM relative to the more recent period when inflation was low.

These improvements, however, are relatively small. The best forecast improvements are in the 10% to 20% range. Employment in the 1960s provides the largest forecast improvement, with a mean absolute error 18% smaller when the ISM payroll index is included in the forecasting equation.

4.5 Why aren't the ISM surveys better predictors?

The ISM indexes do appear to provide some information about subsequent economic measures, but the relatively modest forecast improvements are somewhat surprising. There are two broad reasons why the ISM indexes might have only a limited ability to improve forecasts of official variables.

1. The ISM indexes contain measurement error relative to the official series. As noted, the ISM surveys about 300 firms which are members of the organization. Membership is voluntary, so there is no guarantee that firms surveyed are representative of the activity of all manufacturing firms. While the ISM attempts to account for some of this problem by the NAICS weighting, the survey might also be biased by firm size and even, within industry, by production method.

In contrast, the Census Bureau reports that "the M3 survey panel includes nearly all manufacturing companies with $500 million or more annual shipments and a selection of smaller firms" (Census Bureau [2010]). Thus, the Census sample includes a much larger share of the total manufacturing sector, and includes firms regardless of whether they are members of the ISM. It also makes a specific allowance for small firms, and benchmarks the sample to the Economic Census.

Many of the other relevant government data series, such as the Fed's Industrial Production or the BLS payroll employment, are taken from actual physical output measures or administrative sources. While this data is not without problems, it tends to be more likely to cover a larger share of the manufacturing sector, and to provide information which allows more accurate extrapolation of areas which are not covered.

This comparison of government data with the ISM indexes should not be seen as a criticism of the ISM survey itself. Clearly, there is a tradeoff between obtaining the more complete official measures and the timeliness of the ISM data, and there is nothing intrinsically wrong with the ISM's survey of its members. But the timeliness likely does come at the cost of additional measurement error that may obscure the actual direction of the manufacturing sector.

2. Parameter instability and overall measurement error makes forecasting difficult. Todd E. Clark and Michael w. McCracken [2006,2007] have observed that, for forecasts of inflation using the output gap, "despite seemingly good in-sample fits, the out-of-sample forecast performance of Phillips curve models is mixed." [2006, p1129] Mr. Clark and Mr. McCracken attribute this mainly to the high noise-to-signal ratio in the (relatively) small data sets typically used in such estimates. They also show that parameter instability might reduce the out-of-sample forecasting ability of the model. Although they do not attribute much of the specific problem of estimating Phillips curves parameter instability problem, they emphasize that it remains a potential source of trouble in comparisons like those presented here. The ultimate argument here is that the test of forecasting ability used here is a very difficult one for typical macroeconomic data to pass.

While Clark and Mr. McCracken are satisfied that the theoretical construct of the Phillips curve can survive the estimation problem, it is hard to see how this is the case for the somewhat simpler problem I've encountered in this paper. The null hypothesis is simple: the ISM indexes should predict subsequent official data. The results presented here indicate that the ISM indexes improve forecasts at best only modestly. There are a number of reasons why this might not be the case: the ISM data might be flawed, the official data might be flawed, or parameter instability coupled with the small size of the sample may prevent analysts from obtaining useful estimates. The conclusion in all cases would be the same: the ISM indexes are of limited usefulness to analysts primarily interested in using them to forecast official data.

5. Two Simple Extensions

5.1 Sign Tests

Another, simpler, and easier test is to ask whether the ISM at least predicts the direction of change of the official variables. Table 4 shows the percentage of months when the ISM index correctly predicted the direction of the subsequent movement of the related official series. I have assumed that a value of the diffusion index above 50 should translate into a positive movement in the fundamental series (since more respondents are then saying that activity in this area is rising). The reader should keep in mind that, if the level of the

Table 4: **Sign Prediction Results**
Percent of total observations with correct sign prediction

	1950's	1960's	1970's	1980's	1990's	2000's	Entire Period
Industrial Production	78%	78%	80%	76%	71%	68%	75%
Manufacturing Shipments		68%	75%	73%	64%	65%	65%
Manufacturing Employment	83%	83%	81%	79%	66%	71%	77%
New Orders		57%	73%	64%	58%	63%	62%
Unfilled orders						59%	54%
Inventories		57%	64%	48%	31%	47%	36%
Producer Prices	45%	44%	80%	62%	55%	60%	58%
Real Exports						64%	63%
Imports						62%	63%

ISM index is completely unrelated to the subsequent direction of movement of the official series, the prediction will be correct 50% of the time.

The sign prediction ability varies widely among the different indexes. The employment index got the sign right 77% of the time over the entire period, while the inventory index actually tended to predict the wrong sign (with a correct prediction rate of 36%, some 64% of the sign predictions of the inventory index were wrong). The sign prediction ability also varied over time. The ISM indexes tended to have the most accurate sign prediction ability in the 1950s, 1960s and 1970s, when the production and employment indexes were correct about the direction of movement of industrial production as much as 4/5 of the time. In contrast, the price index preformed poorly during the low-inflation 1950s and 1960s, then—not surprisingly—predicted the sign of the PPI very well in the 1970s when inflation was high. More recently, prediction success rates for almost all series are in the 60% to 70% range except for inventories. The results here suggest that analysts should be very wary of connecting the ISM inventory index to the Census Bureau's inventory series, as the ISM index will predict the direction of movement incorrectly more often than it will predict the direction correctly.

The sign predictions of the ISM in most cases are large enough to allow rejection of the null hypothesis that the true distribution of results is 50%.

5.2 Anticipating Business Cycle Turning Points

Prediction on a month-to-month basis is one thing, but often the most important question is whether a series can predict a business cycle turning point. If the small error reduction noted earlier is concentrated in business cycle turning point periods, the value of the ISM series might be substantially greater than the improvement in the average forecast over the entire period might indicate.

ISM Composite Index
Business Cycle Prediction Record

Peak	Months Before Peak	Trough	Months Before Trough
May-48	False signal		
Nov-48	3	Oct-49	3
Aug 51 to Jul 52	False signal		
Jul-53	1	May-54	2
Aug-57	5	Apr-58	-1
Apr-60	0	Feb-61	-1
Jan 967 to Jul 19	False signal		
Dec-69	-2	Nov-70	-3
Nov-73	-12	Mar-75	-4
Jan-80	5	Jul-80	-1
Jul-81	-1	Nov-82	-2
Apr-85	False signal		
Jul-89	False signal		
Jul-90	2	Nov-82	-2
Jan-92	False signal		
Oct-95	False signal		
Aug-98	False signal		
Mar-01	6	Nov-01	-2
Apr-03	False signal		
Dec-07	-4		
Summary			
Early Signals	6		2
Late Signals	4		8
False Signals	9	n/a	

Table 5 summarizes the preformance of the ISM composite index around NBER-defined business cycle turning points. For this table, the ISM is assumed to give a turning point signal when it registeres 3 months of values below 50. This is arbitrary, althugh consistent with both the NBER's definition of a business cycle as a period of contraction of economic activity and the ISM as a diffusion index (when more than half of surveyed firms are reporting contraction).

The table shows that the ISM index gives a large number of false signals. It is certainly possible to argue that the arbitrary signal I've chosen is too sensitive. However, a less sensitive signal would likely be evne worse at picking up actual business cycle turning points, as this sensitive signal is late in four of the eleven peaks (and eight (!) of the 10 troughs) in the period since the data started. A less sensitive signal would very likely be even later in predicting the turning point.

Of course, the NBER's definition of the business cycle turnint point may not precisely coincide with the turning point in industrial production. (Although the NBER business cycle dating committee cites industrial production as one of five data series that help determine recession timing, so it is possible to overemphasize the differnce between a recession and a sustained decline in industrial production.) An comparison of the signal provided by the ISM index with periods of sustained decline in industrial production doesn't provide much evidence that this is the problem, however. In 1973-74, for example, it took the ISM 11 quarters after industrial production started falling to drop below 50. In the mid-90s, when the economy slowed without undergoing a recession, industrial production started a sustained decline in 1995, but it took nine months before the ISM composite showed three months of below-50 values.

6. Conclusion

The manufacturing ISM surveys provide a view of the current state of manufacturing activity completely separate from official government data. Because the surveys are published two to four weeks before official data, analysts interested in current economic conditions assume that they are a useful indicator of the official data. There is some truth in this assumption, as the indexes provide a modest improvement in forecasting related official series on a month-to-month basis. However, the key word is "modest." The best results—obtained in predicting manufacturing industrial production and producer prices—are an improvement of about 10%. This is a bit worse than in the past, but, even in the 1960s, the forecast improvement obtained with the ISM appears to be modest. The ISM may have some ability to at least predict the direction of subsequent official series, although some analysts may find an error rate of 30% for some series to be relatively high. A simple test suggests that the ISM may not be particularly good at predicting turning points. While more information about the state of the economy is always better, analysts of the business cycle should realize that the ISM surveys do not supercede or fully anticipate more comprehensive official data.

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