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Using the Purchasing Managers' Index to Assess the Economy's Strength and the Likely Direction of Monetary Policy

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When economists are concerned that the economy may be about to change direction, one of the indicators to which they give special scrutiny is the Purchasing Managers' Index (PMI), released monthly by the Institute for Supply Management. This article discusses the construction and interpretation of the PMI and presents evidence of its usefulness as an indicator of growth in the manufacturing sector and the economy as a whole, and as a predictor of changes in Federal Reserve policy. PMI values above 47 generally signal expansion in manufacturing, while the critical value for positive GDP growth is around 40. Over the past fifteen years, PMI values above 52.5 have tended to be associated with rising short-term interest rates.

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Each month, the Institute for Supply Management (ISM) sends a questionnaire on business conditions to purchasing and supply executives in manufacturing firms across the country. Responses to several of the survey questions are combined to form the Purchasing Managers' Index (PMI). As a forecasting tool, the PMI has several attractive features. Chief among them is its timeliness. The PMI for a given month is released on the first business day of the following month and often provides the earliest reading on changes in the economy's strength. Its main rival in this regard is the Labor Department's payroll employment report, which is released on the first Friday of each month and contains data for the prior month. Unlike the PMI, the employment report covers all sectors of the economy. However, it misses the information on sales (orders) and production captured by the PMI. (The Federal Reserve's report on industrial production and the Department of Commerce's report on manufacturers' orders and shipments become available approximately two and four weeks, respectively, after the PMI.

In addition to timeliness, the PMI has the advantage that it is not subject to large revisions. Indeed, the only revisions to the PMI are annual updates to seasonal adjustment factors, which are generally small enough that they can be ignored. The lack of significant revisions is important because to achieve optimal performance from a forecasting model, it is essential that the model be estimated using "real-time-vintage" right-hand-side data—data at each point in the sample that would have been available at that time. Using real-time-vintage data at the estimation stage is critical because it is almost always these data that are ultimately plugged into the estimated equation to produce a forecast (Koenig, Dolmas, and Piger, forthcoming). For many economic time series, gathering these real-time-vintage data is a daunting task.

On the negative side of the ledger, the ISM survey incorporates only information available to corporate executives in the first half of the survey month. If a shock hits the manufacturing sector in the second half of the month, it will not be reflected in the PMI until the following month's survey is compiled and published. Of course, this limitation is hardly unique to the PMI. The payroll employment report, for example, captures only workers who are on firms' payrolls during the pay period that includes the 12th of the month.

Another potential limitation of the PMI arises from the fact that it—unlike the employment release—is a diffusion index: A high PMI reading simply means that more executives are reporting improving business conditions than are reporting deteriorating business conditions. There is no attempt to capture differences across firms or over time in the *intensity* with which conditions are changing. Nor are the responses of different firms weighted by firm size. It follows that the PMI may miss a shift in the direction of the overall economy if that shift happens to be concentrated in a relatively small number of large firms.

I begin by providing background information on the ISM survey and the PMI, including a description of who participates in the survey, the survey's timing, and how the PMI is constructed. Next, I discuss the usefulness of the PMI as an early signal of changes in manufacturing output and gross domestic product (GDP). The evidence suggests that the PMI captures information about GDP growth beyond that contained in the Federal Reserve's report on industrial production and official government reports on employment and retail sales. Given these results, it may come as no surprise that the PMI is a strong predictor of changes

in monetary policy, as measured by the Federal Reserve's federal-funds-rate target.

PMI BACKGROUND[1]

Basics

The ISM (formerly known as the NAPM, or National Association of Purchasing Management) has conducted its survey of purchasing and supply executives continuously since the end of World War II. The survey goes out to executives representing more than 400 companies in twenty manufacturing industries spread across all fifty states.[2] These executives are asked about new orders their firms have received and about their firms' production, employment, inventories, order backlogs, new export orders, and imports of materials and supplies. In each case, executives are asked whether the variable's current level is higher (or better), lower (or worse), or the same as during the preceding month. To the percentage of executives who report higher levels of a variable is added half the percentage who report an unchanged level to create a diffusion index for that variable. Thus, an index reading above 50 indicates that more executives are reporting better values for a variable than are reporting worse values. The higher the index reading, the greater the preponderance of positive responses. Executives are also asked whether their customers' inventories are too high, too low, or about right; whether supplier deliveries are slower, faster, or about the same as during the prior month; and whether suppliers are charging prices that are higher, lower, or about the same. Diffusion indexes for customer inventories and prices paid are constructed in much the same way as those for new orders, production, and so forth already discussed. In contrast, the supplier-deliveries index is higher if a greater preponderance of executives report *slower* supplier deliveries. Each index is adjusted for normal seasonal variation.

The PMI combines the information in the New Orders (30 percent weight), Production (25 percent weight), Employment (20 percent weight), Supplier Deliveries (15 percent weight), and Inventories (10 percent weight) indexes. According to the ISM, a PMI reading above 50 indicates that the manufacturing sector of the economy is generally expanding, and a reading above 42.7 indicates that real GDP is expanding. (These rules of thumb are updated below.) Figure 1 shows a plot of the PMI from January 1948 through June 2002. Clearly, there is a close (though imperfect) correspondence between periods in which the PMI is low and periods in which the National Bureau of Economic Research (NBER) has determined that the economy was in recession (the shaded bars).[3]

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[1] This section draws on information from the ISM web site (www.napm.org) and from Rogers (1998).

[2] The twenty industries are Food; Tobacco; Textiles; Apparel; Wood and Wood Products; Furniture; Paper; Printing and Publishing; Chemicals; Petroleum; Rubber and Plastic Products; Leather; Glass, Stone, and Aggregate; Primary Metals; Fabricated Metals; Industrial and Commercial Equipment and Computers; Electronic Components and Equipment; Transportation and Equipment; Instruments and Photographic Equipment; and Miscellaneous. An effort is made to survey executives from a representative cross section of these industries. In total, the ISM has nearly 50,000 members.

[3] The NBER has yet to announce an ending date for the most recent recession. Figure 1 assumes that December 2001 will eventually be declared the trough month.

Other Purchasing Managers' Surveys and Indexes

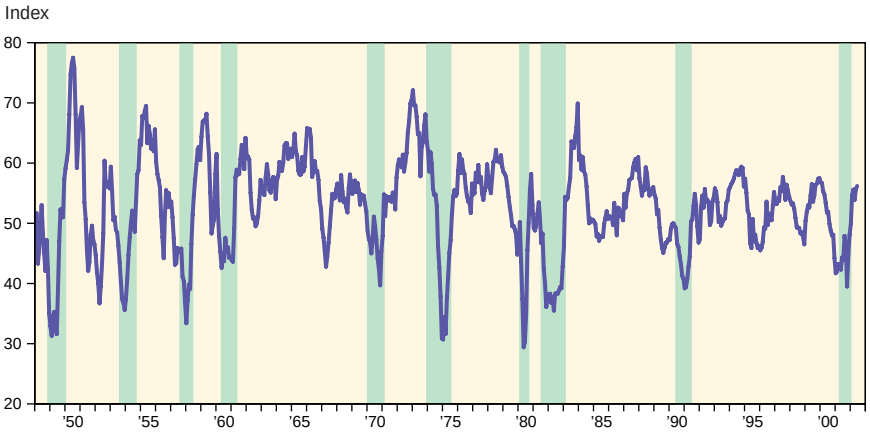
Besides the ISM national survey of executives in the manufacturing sector, there are numerous local purchasing managers' surveys and indexes and a national survey of purchasing executives in nonmanufacturing firms. Local indexes are meant to track the ups and downs of particular cities' economies. They are constructed by local ISM affiliates using a methodology similar to that used for the national PMI. The Purchasing Management Association of Chicago, for example, publishes an index that receives considerable attention because of its timing (it is released prior to the national PMI) and because of the number of major manufacturing firms with offices in Chicago. Within the Eleventh Federal Reserve District, there is a Dallas/Fort Worth purchasing managers' index (begun in 1999) and a Houston index (begun in 1995). The surveys upon which the local indexes are based are conducted independently of the national survey and play no role in the construction of the national PMI.

The manufacturing sector of the economy is much more cyclical than the service-producing sector but accounts for ever-shrinking shares of total employment and spending.[4] To achieve more complete coverage of the economy, the ISM has begun a monthly survey of purchasing managers outside the manufacturing sector. Results from this survey are released a few days after release of those for the manufacturing sector. Unfortunately, at five years, the track record of the new survey is too short to properly evaluate. Moreover, there is no weighted composite index for the nonmanufacturing sector like there is for the manufacturing sector. Accordingly, this article focuses exclusively on the national PMI.

THE PMI AS A TOOL FOR FORECASTING OUTPUT GROWTH

The timeliness and convenience of the PMI don't count for much if the index doesn't contain useful information on the economy—especially information beyond that captured by other published data series. This sec-

Figure 1
ISM's Purchasing Managers' Index



NOTE: Shaded areas indicate recessions.

SOURCE: Institute for Supply Management.

[4] The share of manufacturing output in nominal GDP fell from 27.0 percent in 1960 to 21.0 percent in 1980 to 15.9 percent in 2000. Over the same period, the share of manufacturing employment in total employment dropped from 31.0 percent to 22.4 percent to 14.0 percent.

tion presents evidence of the PMI's ability to predict changes in manufacturing output and real GDP. The marginal predictive power of the PMI for GDP growth is given special attention for two reasons. First, the usefulness of the PMI for predicting changes in manufacturing output has already been established (Harris 1991, Rogers 1992). Second, however strongly the PMI may be related to factory output, the manufacturing sector's diminishing relative size raises the legitimate concern that the PMI may have become irrelevant for predicting changes in the strength of the economy as a whole.

Simple Forecasting Relationships

A regression of manufacturing output growth on the PMI yields the following results:

$$\Delta q = 0.70\ (pmi - 47.77) + 0.84\ \Delta pmi \qquad R^2 = 0.650$$
$$\quad (0.13) \qquad (0.80) \quad (0.11) \qquad \text{S.E.} = 5.69$$

over a sample period running from second quarter 1948 through second quarter 2002. Here, Δq is the within-quarter annualized percentage growth rate of manufacturing output, as measured by the Federal Reserve Board; *pmi* is the quarterly average value of the PMI; and Δpmi is the change in the PMI's quarterly average value.[5] Standard errors are in parentheses.[6] According to these results, factory output growth depends about equally on the level of the PMI and the PMI's most recent change. A 1-point permanent increase in the PMI implies an immediate 0.70 + 0.84 = 1.54-percentage-point increase in annualized factory output growth, but only a 0.70-percentage-point increase in subsequent quarters. The critical value for the PMI—the reading that is consistent with a stagnant manufacturing sector—is significantly less than 50.[7]

The relationship between the PMI and real GDP growth is similar to, but not quite as tight as, that between the PMI and output growth in the manufacturing sector:

$$\Delta y = 0.28\ (pmi - 40.85) + 0.29\ \Delta pmi \qquad R^2 = 0.466$$
$$\quad (0.06) \qquad (1.42) \quad (0.07) \qquad \text{S.E.} = 3.01$$

The sample period runs from third quarter 1948 through first quarter 2002, Δy denotes the annualized quarterly growth rate of real GDP, and *pmi* is

[5] More precisely, $\Delta q(t) \equiv 400[q(t, 3) - q(t - 1, 3)]$ where $q(t, i)$ is the logarithm of manufacturing output in the ith month of quarter t. Both here and in similar regressions reported below, I use current-vintage output growth as the dependent variable. Presumably, the most up-to-date available estimates of output growth are the most accurate, and it is the most accurate measure of growth that the forecaster will want to predict. Even so, there is an advantage to using early estimates of growth as the dependent variable for regression purposes if these growth estimates are efficient—that is, if revisions to the early releases are unpredictable using information available at the time. Unfortunately, early estimates of output growth are not readily available over the full sample period used here. Moreover, early estimates of industrial production growth (which might be expected to have properties similar to those of early estimates of manufacturing output growth) are *in*efficient predictors of subsequent releases. (The evidence for early GDP growth estimates is more favorable to the efficiency hypothesis, but, again, available data are limited.) For a more complete discussion of when estimation using early-release data is appropriate, see Koenig, Dolmas, and Piger (forthcoming).

[6] Here and elsewhere in this article, standard errors are corrected for possible heteroskedasticity and serial correlation.

[7] Harris (1991) and Rogers (1992) report similar results.

month annualized percent change in manufacturing output along with a three-month average of the PMI from December 1983 to June 2002 (the same period covered by the regression results above). The chart is constructed so that zero factory output growth lines up with a PMI reading of 47 (which approximates the estimated critical value over the interval displayed). Note how the PMI captures sustained movements in output growth while smoothing out much of the short-term "noise." This filtering effect is an additional attractive feature of the PMI, relative to direct measures of output growth.

Evidence of Marginal Predictive Power for GDP Growth

As mentioned above, the Labor Department's employment report is released on about the same schedule as the PMI and provides an alternative early source of information on GDP growth. Retail sales and industrial production reports are released with a longer lag than employment and the PMI, but still early enough that they too can be used to forecast GDP. (The first official estimate of each quarter's GDP isn't released until a full month after the end of the quarter.) By putting jobs, sales, and industrial production data together with the PMI on the right-hand side of a regression equation that has GDP growth as its dependent variable, it's possible to determine whether the PMI has any predictive power beyond these measures of economic activity. To make this test a fair one, it is important that only the relatively early jobs, sales, and production data that would have been available to a forecaster in real time be included in the regression.

Why Have the Links Between the PMI and Output Growth Changed?

As noted in the main text, the change in the PMI seems to be every bit as important as the level of the PMI for predicting output growth over much of the post–World-War II period. Over the past twenty-odd years, however, the predictive power of PMI changes disappears. Equivalently, during the 1950s, 1960s, and 1970s, the PMI initially underresponded to changes in the rate of output growth. No such temporary underresponse is evident from the mid-1980s on.

One possible explanation for the changed relationship between the PMI and output growth centers on the behavior of materials inventories and the fact that the PMI includes, as one of its components, the ISM's Inventories Index. If an expansion of output is initially accompanied by a drawdown of materials inventories, then the Inventories Index will drop even as other PMI components (New Orders, Production, Employment, and Supplier Deliveries) signal expansion by rising. Hence, the Inventories Index initially acts as a restraining force on the PMI. It exerts a similar temporary restraining force in the opposite direction if output suddenly contracts.[1] Note that these effects are smaller the more tightly firms control their inventories. Tighter inventory controls are sometimes cited as an important contributor to the greater stability of output growth in the period since 1983 (McConnell and Perez-Quiros 2000).

A second explanation centers on the fact that the ISM has tended to oversample large, well-established firms. This sampling bias means that insofar as newer, smaller firms are relatively quick to adjust their production to shifts in demand, the PMI initially underestimates changes in output growth. Of course, the distortion shrinks if the agility differential between small and large firms narrows or if the ISM makes its survey sample more representative. There are reasons to suspect that both of these changes have occurred. For example, the ISM has expanded the size of its sample: Executives at nearly 400 firms are included in the ISM survey today, compared with 300 firms in the early 1990s and about 225 firms in the early 1980s (Harris 1991; www.napm.org). The greater responsiveness of production to demand has been widely noted in the business press and in the public testimony of policymakers (Greenspan 2002).

NOTE

[1] Consistent with this story, movements in the ISM Inventories index lag movements in the PMI by about two months.

along with the centered three-month change in the target federal funds rate set by the FOMC. The correlation between the two series is high (0.76 over the full sample and 0.87 over the past four and a half years). Typically, the FOMC has raised the funds rate when the PMI registers above 52.5 and lowered the funds rate when the PMI registers below 52.5. Of course, the FOMC may not be responding to the PMI at all, but to information from entirely different sources that moves similarly to the PMI.[11]

In any case, the relationship shown in Figure 3 is coincident, not predictive. Testing the PMI's usefulness for *forecasting* monetary policy requires including the PMI—along with measures of inflation, economic slack, and real growth—as a right-hand-side variable in a regression explaining future changes in the FOMC's target funds rate. The use of real-time-vintage data is critical, just as it was in our earlier GDP forecasting exercises. The analyst who estimates funds-rate equations that include data that would have been unavailable to policymakers can easily draw incorrect conclusions about FOMC behavior (Orphanides 2001) and will find that the equations do a poor job of forecasting future funds-rate changes.[12]

The regression equation estimated here takes the form $ff - ff_{-i} = \alpha(ff^*_{-i} - ff_{-i})$, where ff is the end-of-month target funds rate and ff^* is a long-run target rate toward which the FOMC gradually moves. This long-run target rate is a function of inflation (π), labor-market slack as measured by the unemployment rate (u), recent jobs growth (Δe), and the most recent PMI (pmi):

$$ff^* = \alpha_0 + \alpha_1\pi + \alpha_2 u + \alpha_3\Delta e + \alpha_4 pmi.$$

The coefficients α_1, α_2, α_3, and α_4 measure the funds rate's eventual response to a 1-percentage-point increase in each of its determinants. Some economists have argued that α_1 must be greater than 1 if monetary policy is to be stabilizing: Only if $\alpha_1 > 1$ will the *real* federal funds rate ($ff - \pi$) rise in response to high inflation and economic conditions that tend to increase inflation over time, and it takes an increase in the real funds rate to choke off excess aggregate demand (Clarida, Gali, and Gertler 2000). The larger is α, the more quickly the funds rate responds to changes in its determinants. All data used in the funds-rate regression are real time.[13]

[11] Federal Reserve Bank directors are one such source. Another is the Federal Reserve's own Beige Book survey. For a description of the Beige Book and documentation of its usefulness as a forecasting tool, see Balke and Petersen (2002).

[12] The Scylla to this Charybdis is to exclude from the regression some variable that policymakers relied on in reaching their decisions. Again, the analyst may draw inappropriate conclusions about policymakers' behavior (Lansing 2002). However, left-out-variable error does not result in systematically biased out-of-sample forecasts.

[13] Employment growth is measured by 200 times the six-month change in the logarithm of nonfarm employment. Measuring the employment change over a shorter period did not substantially alter results. Inflation is measured by the twelve-month percentage change in the core Consumer Price Index (CPI) from the beginning of the sample period through December 1995. CPI inflation data are not revised. From December 1999 through the end of the sample, inflation is measured by real-time official estimates of the four-quarter percentage change in the core Personal Consumption Expenditures (PCE) Price Index (with correction for September 11 insurance distortions). During 1996–99, inflation is measured by a weighted average of core CPI and real-time core PCE inflation rates, with a gradually falling weight on CPI inflation and a gradually increasing weight on PCE inflation. Fed policymakers' increasing attention to PCE inflation at the expense of CPI inflation is evident in Greenspan's semiannual reports to the Congress during the late 1990s. The constant term, α_0, in the regression equation was allowed to shift gradually along with the weighting between the CPI and PCE inflation measures. Results change little when the core CPI inflation measure is used over the full sample and α_0 is held fixed.

SUMMARY AND CONCLUSIONS

The Purchasing Managers' Index is a valuable tool for tracking the health of the economy's manufacturing sector. It is available on a more timely basis than other, more direct measures of factory output growth. Unlike these other measures, it is not subject to significant revisions, and it seems to capture output growth trends while filtering out a lot of transitory variation. The most recent twenty years of data suggest that factory output growth tends to be positive or negative depending on whether the PMI is above or below 47.

The PMI also conveys useful information about real GDP growth. The threshold for positive GDP growth is a PMI reading of around 40—substantially lower than the reading that serves as a growth threshold for the manufacturing sector. End-of-quarter changes in the PMI have useful information for aggregate output beyond the information contained in the official reports on employment, retail sales, and industrial production that are available at or near the close of the quarter. Early estimates of these other variables miss end-of-quarter fillips to GDP growth that the PMI does not.

Federal Reserve officials draw on information from a wide variety of sources to gauge the health of the manufacturing sector, which—because of its interest-rate sensitivity—is an important factor influencing policy decisions. The PMI is highly correlated with trends in factory output growth, and policy changes, in turn, are highly correlated with contemporaneous values of the PMI. A forecasting model that draws on the most recent PMI—along with real-time inflation, unemployment, and jobs-growth data—does a good job of predicting the general thrust of Federal Reserve policy over the past fifteen years.

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