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Is the Purchasing Managers' Index useful for assessing the economy's strength? A directional analysis

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Abstract

The Purchasing Managers' Index (PMI) is one of the key variables to which economists pay considerable attention for assessing US economic activities, particularly, business conditions in the manufacturing sector. Although the PMI has been used to assess the US economy, there is hardly any attempt to evaluate the directional accuracy of the PMI to predict the direction of change in the index of industrial production (IP) and Gross Domestic Production (GDP). We present evidence that the PMI is a useful predictor of the direction of change in the IP, particularly in the recent decade.

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1. Introduction

The Purchasing Managers' Index (PMI) is widely recognized as the earliest indicator of the US economy. The PMI for a given month is released on the first business day of the following month, and it usually gives us the earliest information on changes in the economy's performance, which is usually measured by Gross Domestic Product (GDP). The PMI is also considered a good indicator of the index of industrial production (IP), which is one of the most important indices for assessing economic conditions. For example, the National Bureau of Economic Research determines whether the economy is in expansion or contraction, using the IP as one of the definitive indicators.

Some studies, in fact, show that the PMI is a good indicator of the IP and the economy as a whole. Harris (1991) and Rogers (1992) examine how well the PMI forecasts the IP, and establish the fact that the PMI successfully predicts the IP[1]. Kauffman (1999)[2] concludes that the PMI has many desirable indicator qualities of business and economic activity. Koenig (2002) also discusses whether the PMI forecasts the IP and GDP, and shows a close relationship between the PMI and the federal funds rate, which is an instrument of monetary policy determined by the Federal Reserve's Federal Open Market Committee. Pelaez (2003a, 2003b) also points out that financial markets may react to changes in the PMI partly from expectations that the Federal Reserve may change its policy stance. Lindsey and Pavur (2005) provide a regression model to forecast turning points for the index and anticipate changes in the general business cycle. Cho and Ogwang (2006) examine the weighting scheme of the index and show that the PMI series they offered outperforms those proposed by other studies.

Therefore, the PMI may provide valuable information about the qualitative conditions of the economy such as the acceleration and deceleration of economic activity. To investigate whether the PMI predicts the acceleration and deceleration of the IP and GDP, we use directional tests proposed by Henriksson and Merton (1981). Schnader and Stekler (1990) applied this technique for the evaluation of macroeconomic forecasts[3]. Forecasts are considered useful if they predict the acceleration and deceleration better than a naïve model.

According to Pesaran and Timmermann (2004), directional analysis is recognized as an increasingly popular metric for forecasting performance. However, few studies focus on the

[1] Considerable effort has been devoted to forecasting the IP. It dates back at least to Maher (1957).

[2] It also reviews and summarizes early studies on the PMI.

[3] See, for instance, Ash et al. (1998), Ashiya (2006), Artis (1996), Baghestani (2011), Greer (2003), Joutz and Stekler (2000), Leitch and Tanner (1995), Pons (2000), and Sinclair et al. (2010).

directional accuracy of forecasts by corporate managers whereas Easaw and Heravi (2004) and Easaw et al. (2005) examine the directional accuracy of consumer sentiment indexes in the UK and US and find that they are useful predictors of household consumption growth.

As a result, we find that the PMI is a useful tool to forecast the direction of change in the IP. It is noteworthy that it is useful in the recent decade but was not so in the decade from 1991 to 2000.

The rest of the paper is organized as follows. Section 2 describes our data. Section 3 introduces statistical methods. Section 4 presents the results of directional tests and the last section presents conclusions.

2. Data

We collect real-time data[4] from the ArchivaL Federal Reserve Economic Data (ALFRED). The original data sources are the Federal Reserve Board for the IP, the Bureau of Economic Analysis for GDP, and the Institute for Supply Management (ISM) for the PMI. Since one of the main advantages of the PMI is its timely release[5] and we investigate whether the index gives an early signal of the economy, we restrict our study to the period January 1991– December 2010.

ISM asks purchasing and supply managers in manufacturing firms about business conditions in the middle of each month. The answers to the survey questions in each category are combined to create a diffusion index for that sub-index[6]. We use one of the sub-indexes, PMI Production, in addition to the PMI because the former might be a better indicator of the IP. Furthermore, we consider the sub-indexes, PMI Employment, because Cho and Ogwang (2006) proposed it as a simpler and parsimonious PMI without loss of too much information. Following them, we call it Simple PMI. Note that ISM revised the weighting scheme in January 2008[7]. Note also that the ALFRED database reflected this revision.

A PMI reading of above 50 would indicate that more managers are reporting better than are reporting worse. Thus, an increase in overall manufacturing activity is implied by an index above 50, and a decrease by an index below 50. Thus, an acceleration in business conditions,

[4] Ashiya (2006) pointed out that the revised data introduces a systematic bias because the extent of revision is unpredictable for the forecasters. See also Stark and Croushore (2002).

[5] ISM has started to follow the current release schedule for its PMI since the summer of 1989.

[6] See Koenig (2002) for details about the PMI.

[7] See its Web site ISM (2008).

which means that the direction of change is positive, could be interpreted as the first difference of the level of the index. We have the PMI figures, for example, 55 for this month and 52 for last month. These figures imply a 5-point and 2-point increase in activity, respectively, compared with the previous month. The difference between them—3 points—can be interpreted as an acceleration in manufacturing activity as a whole.

To capture the direction of changes in the IP (GDP) (ΔR), we define it as $\Delta R_t = R_t - R_{t-1}$, where R_t denotes the percentage change of the IP (GDP) in time t. We also define $\Delta F_t = F_t - F_{t-1}$ as the direction of change in the PMI (ΔF), where F_t denotes the level of the PMI. We take the three-month average to construct the quarterly series of the PMI to match the data frequency of GDP figures.

Figure 1 gives an informal sense of how well the PMI has served to signal changes in growth of the IP. Figure 2 shows plots of three-month average PMI series along with GDP growth. Note that the figures are constructed so that zero IP and GDP growth line up with a PMI reading of 50, respectively. They indicate that the PMI series roughly capture sustained movements in growth of the IP and GDP, respectively. They also suggest that the PMI has a closer relation with growth in the IP and GDP in the second half of the sample period, in particular, after 2005. Therefore, we examine the usefulness of the PMI series in the first and second halves as well as the total sample period. Table 1 shows summary statistics for each data series used in this paper.

3. Statistical Method

We use Fisher's exact test based on contingency tables[8] to show whether the forecasts (PMI) predict the direction of change in the realization (IP and GDP). Then we define the following: n_{00} = number of forecasts for which $\Delta F > 0$ and $\Delta R > 0$, n_{01} = number of forecasts for which $\Delta F \le 0$ and $\Delta R > 0$, n_{10} = number of forecasts for which $\Delta F > 0$ and $\Delta R \le 0$, n_{11} = number of forecasts for which $\Delta F \le 0$ and $\Delta R \le 0$, and n = total number of forecasts. The observed significance level for the usefulness of the forecasts is given by[9]

$$\sum_{x=n_{11}}^{n^*} \binom{n_{10}+n_{11}}{x} \binom{n_{00}+n_{01}}{n_{01}+n_{11}-x} \Big/ \binom{n}{n_{01}+n_{11}} \quad \text{where } n^* \equiv \min\{n_{10}+n_{11},\ n_{01}+n_{11}\}.$$

[8] See Henriksson and Merton (1981).

[9] Note that $\binom{n}{r}$, for example, denotes the number of combinations of n objects taken r.

The null hypothesis is that the direction of change in a forecast and that in the realization are independent. A rejection of the null hypothesis therefore implies that the PMI figures are useful predictors of actual change in the IP (GDP). Schnader and Stekler (1990) showed that a rejection of the null of independence also implies that a given set of forecasts differ significantly from a naïve model in predicting the direction of change.

4. Result

Table 2 shows the results of the directional tests. It indicates that test statistics of the PMI are significant at the 5% level in the entire period from 1991 to 2010 and in the second half period from 2001 to 2010 for the IP. Therefore, the PMI is a useful predictor of the direction of change in the IP in the whole sample period and in the latter half. However, it is not useful in the first half of the sample period. Better predictability in the recent decade is consistent with the fact that there is more sophisticated inventory management[10] available.

However, the PMI is not useful in predicting the direction of change in GDP in any sample period. A possible reason for this weak relationship between the PMI and GDP is that the share of manufacturing output in nominal GDP has been declining over the sample period.

Although the test statistics of the PMI to predict the direction of change in GDP is not even significant at the 10% level in the second half, the p-value dropped from 0.525, the one in the first half, to 0.110. This might be partly due to the revision of the weighting scheme of the PMI because the revised formula for calculating the PMI was determined to more closely predict GDP. However, it is noted that the new formula has been applied since January 2008[11]. It suggests that the PMI could be a useful predictor of the direction of change in GDP after 2008, which cannot be examined yet because of limited number of observations. It also implies that the fact that the PMI is useful indicator of the direction of change in the IP in the second half but not in the first half is not driven only by the shift of the weighting scheme since the revision does not taken into account whether the PMI predicts the IP.

The PMI Production and Simple PMI are not useful predictors of the IP or GDP; thus, they do not contain valuable information about the IP and GDP. Although Cho and Ogwang (2006) showed that the Simple PMI had good performance based on its correlation with the IP and

[10] Improved inventory management is also considered as one of reasons for the Great Moderation. For example, see Summers (2005).

[11] The PMI prior to January 2008 did not reflect the new weighting calculation.

GDP, it turns out not to be a good indicator of the acceleration and deceleration of the IP and GDP.

5. Conclusion

We investigate whether the PMI predicts the acceleration and deceleration of the IP and GDP using directional tests. Our findings show evidence that the PMI is a useful predictor of the IP in the recent decade and it might reflect the improvement of inventory management in the manufacturing sector. This result also supports our extensive use of the PMI to assess the economic conditions in the manufacturing sector in recent years. For future research, further analysis with a larger data set is required because our data is limited to the period from 1991.

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Figure 1. PMI and IP growth

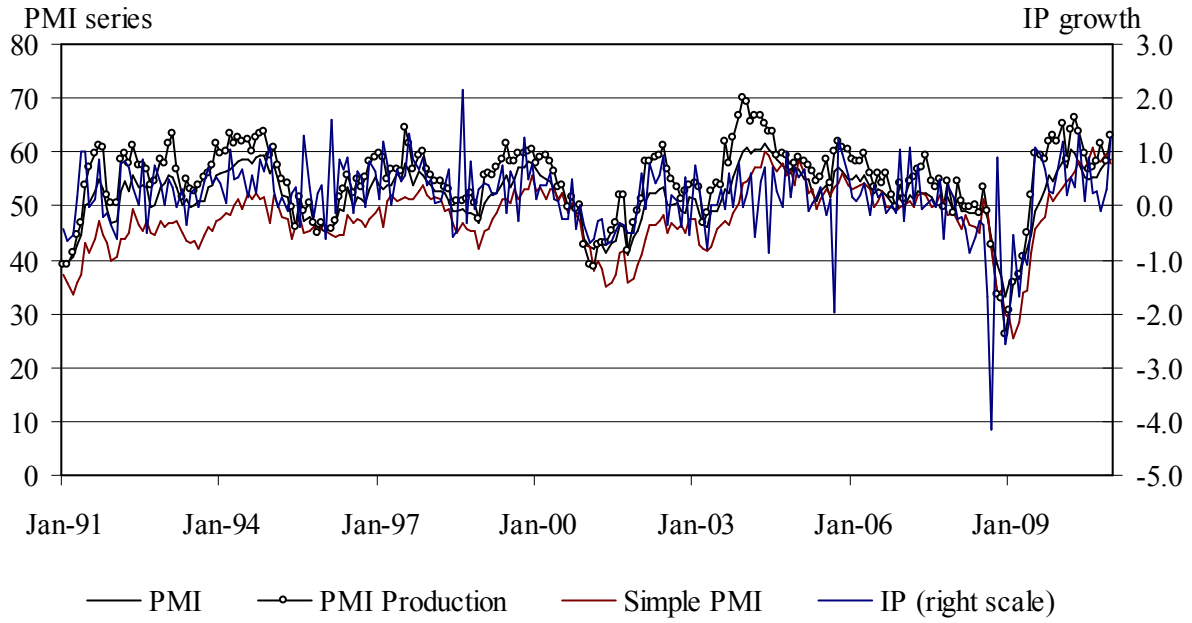

Figure 2. Three-month average PMI and GDP growth

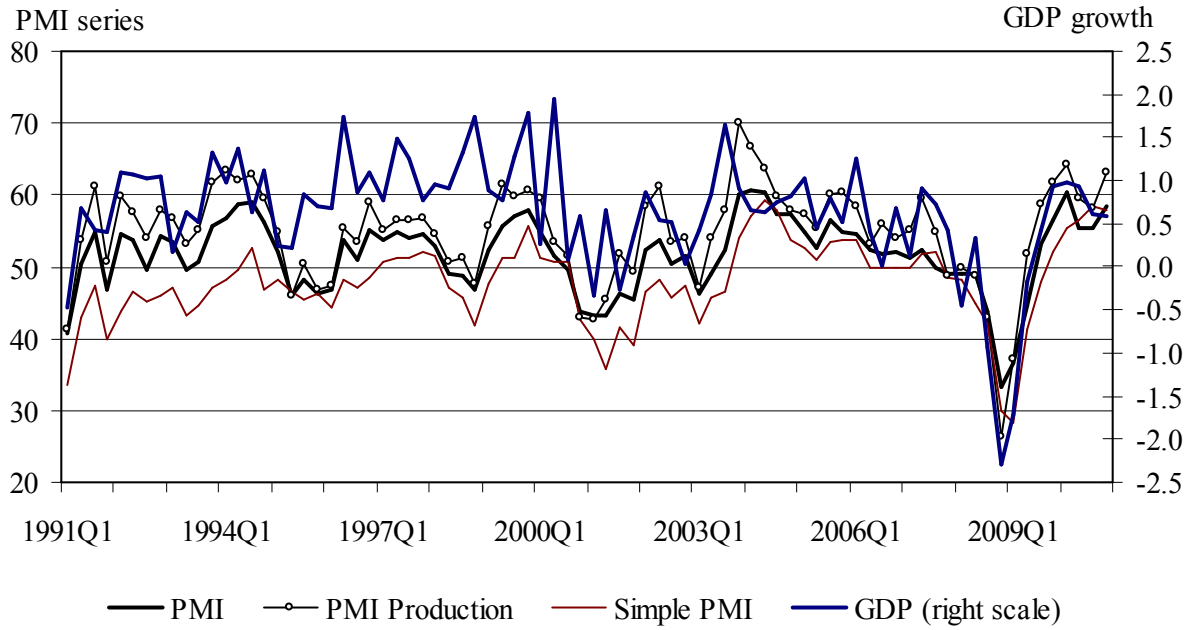

Table 1. Summary statistics

	PMI	*PMI Production*	*Simple PMI*	*IP*	*GDP*
minimum	33.3	26.3	25.3	-4.1	-2.3
median	52.4	56.0	48.1	0.2	0.7
mean	51.7	54.8	47.9	0.2	0.6
maximum	61.4	70.0	60.7	2.2	2.0
standard deviation	5.3	7.0	6.1	0.68	0.70

Notes: Summary statistics for PMI, PMI Production and Simple PMI are calculated with levels of each index. Summary statistics for IP and GDP are calculated with each growth rate. The sample period is from 1991 to 2010 for all variables.

Table 2. Results of directional tests

	IP	*GDP*
Whole period: 1991–2010		
PMI	0.043*	0.071
PMI Production	0.255	0.653
Simple PMI	0.897	0.822
First half: 1991–2000		
PMI	0.714	0.525
PMI Production	0.855	1.000
Simple PMI	0.715	0.752
Second half: 2001–2010		
PMI	0.023*	0.110
PMI Production	0.058	0.751
Simple PMI	0.855	1.000

Notes: p-values are shown. * indicates that the null hypothesis is rejected at the 5% significance.