Evaluation of the Australian Industry Group / PricewaterhouseCoopers - Performance of Manufacturing Index (Ai-PMI)

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Disclaimer: An important qualification to the analysis presented below is that the PMI covers the period 1992-2000, in which the Australian economy experienced the longest expansion in the last century. While there was a mid-cycle pause in 1996, there was no classical contraction in Australia between 1992 and September 2000. An economic contraction (in quarter-ended terms) in the December quarter of 2000 could be a turning point of the economic expansion in the last decade. Thus there is limited evidence on which to base an assessment of the business cycle features of the PMI. For this reason the assessment is based on correlation between it and other variables. The assumption being employed here is that the correlation observed during an expansion would not be too different from those observed during contractions.

1. Introduction

The purpose of this paper is to evaluate the Australian Industry Group / PricewaterhouseCoopers Performance of Manufacturing Index (Ai-PMI) as a tool for analysis. Particular interest focuses on the issue of how useful it is as an early signal of Australian business cycle turning points.

The paper is organised as follows. The first section introduces the Ai-PMI and the United States National Association of Purchasing Managers – Purchasing Managers Index (NAPM-PMI) upon which it is based. In this first section we examine the record of the NAPM-PMI in signalling classical and growth cycle recessions for the United States. We then explore the empirical relationship between the NAPM-PMI and the Ai-PMI, and whether the research that links the NAPM-PMI to the US business cycle can be used to provide helpful rules of thumb for interpreting what the Ai-PMI says about the Australian business cycle. The relationship between the Ai-PMI and the ABS data on manufacturing production is also examined.

The first section takes the Ai-PMI as given and studies its properties. In the second section we explore two issues viz. alternative weighting schemes and how to construct an index that combines the Ai Group survey data with ABS data. The third section further examines the PMI by comparing it with the indices of Australian aggregate economic activity, complied by the Melbourne Institute. The final section provides conclusions and recommendations.

2. The Ai-PMI and NAPM-PMI

The Ai-PMI is a seasonally adjusted national composite index based on the diffusion indices[1] for – production, new orders, deliveries,[2] inventories and employment.[3] The data for the Ai-PMI comes from Ai Group / PricewaterhouseCoopers Survey of Australian manufacturing. By construction, a PMI reading above 50 per cent indicates

[1] These diffusion indices combine the survey reporting of positive increases for each of the five indicators plus half of the no change responses in each survey quarter.
[2] The indicator of deliveries was added into the PMI in the September quarter of 1998.
[3] Currently, the weights are 0.25 for production, 0.3 for new orders, 0.2 for employment, 0.1 for inventories and 0.15 for deliveries.

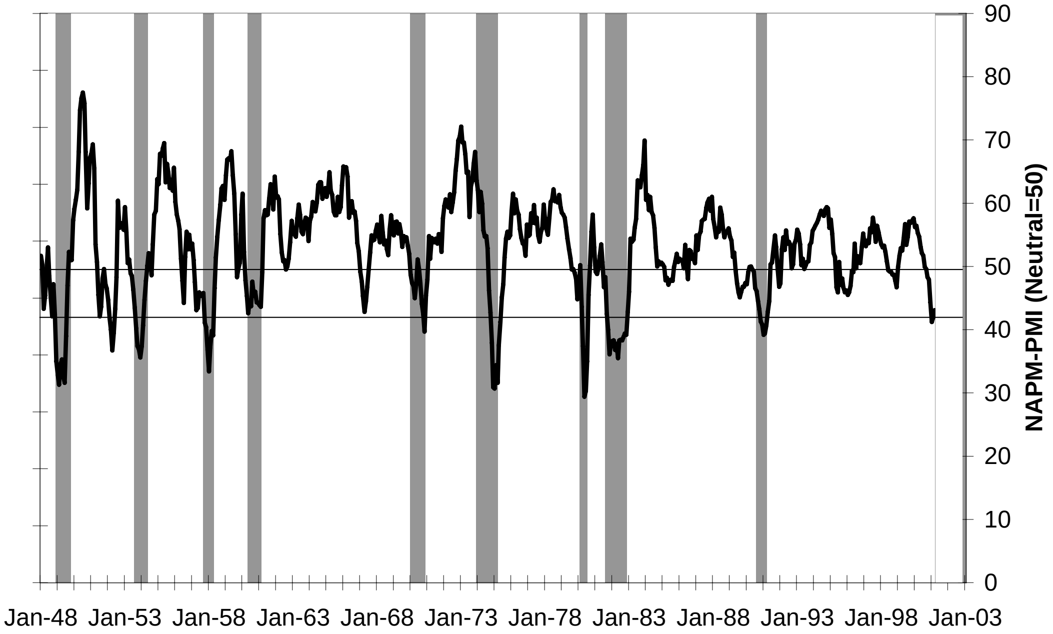
that manufacturing is generally expanding; below 50 per cent, that it is declining. The distance from 50 per cent is indicative of the strength of the expansion or decline.

The idea underpinning indices such as the NAPM-PMI and the Ai-PMI is that production, new orders, employment, inventories and deliveries are driven by a common factor. Averaging across these series reduces idiosyncratic variation and makes the common factor more pronounced. More details on the NAPM-PMI are at the NAPM website (www.napm.org). Information about the Ai-PMI are in *Survey of Australian Manufacturing* and can be accessed at their website (www.aigroup.asn.au).

2.1. Relationship between NAPM-PMI and the United States business cycle

As is shown in Figure 1, the NAPM-PMI is a reliable indicator of the US classical cycle.[4] Contraction phases in that cycle are shown as the shaded grey bars. With one exception in the 1950s, every time the NAPM-PMI has fallen below 42.7 the US has gone into recession. This rule of thumb is used by the NAPM in reading their index.

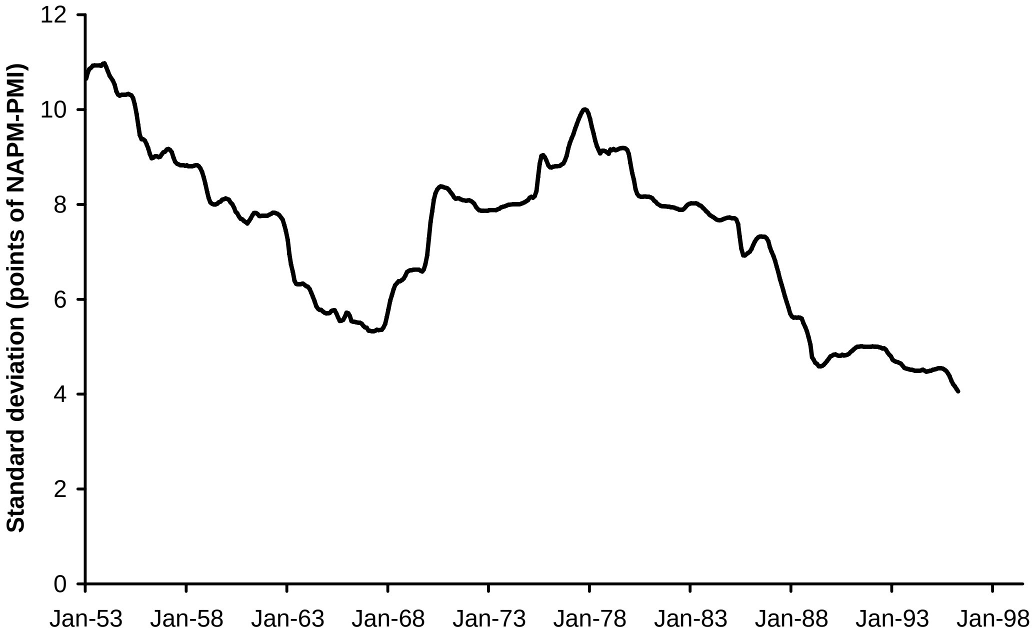
Figure 1: NAPM-PMI and United States classical cycle



[4] The classical cycle refers to the pattern of peaks and troughs and the level of series. The NBER reference cycle is the consensus, arrive at by a committee, regarding the pattern of peaks and troughs in several series.

There are two issues with this rule of thumb. First, as is shown in Figure 2 there has been significant variation over time in the volatility of the NAPM-PMI. Specifically volatility is much lower after the mid 1980s than before that date. This raises the issue of whether a number higher than 42.7 might be appropriate as a critical value in the latter period.

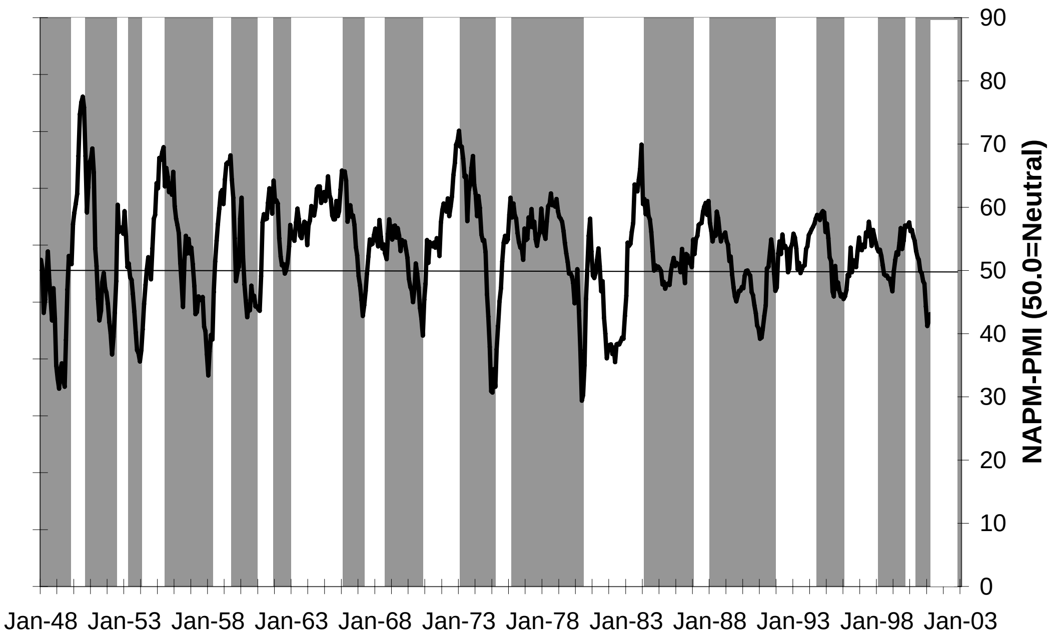
Figure 2: Centred rolling 10 year standard deviations of NAPM-PMI



The second issue is that we are not convinced that this level rule provides as early a warning of recession as is feasible. An alternative rule might be to call a classical recession when the NAPM-PMI falls by more than say 18 points. One could take into account the reduced volatility after 1984 by using a fall of 14 points after that date as a signal of recession. Whereas the 18 point rule would have missed the 1990's US recession the latter rule would have called that recession in July of 1989. That is it would have provided almost a year advance warning. This rule would not have produced any false calls since 1990. In December 2000 the NAPM-PMI had fallen by 13.3 points from its previous peak and thus was very close to calling a classical recession using this rule.

The classical cycle is not the only cycle of interest. Policy makers are often interested in the growth cycle[5], which is shown by the gray bars in Figure 3. The NAPM does not recommend a rule of thumb for using the NAPM-PMI to read the growth cycle. However, inspection of Figure 3 shows that in the period prior to 1984 a fall in the NAPM-PMI of 10 points reliably signals a growth cycle contraction while in the less volatile post 1984 era a fall of 7.5 points signals a growth cycle contraction. This issue requires more research but the rules of thumb above seem potentially useful. Moreover as is discussed below it may be possible to translate this US experience directly into rules of thumb for interpreting the implications of the Ai-PMI for the Australian business cycle.

Figure 3: NAPM-PMI and United States growth cycle



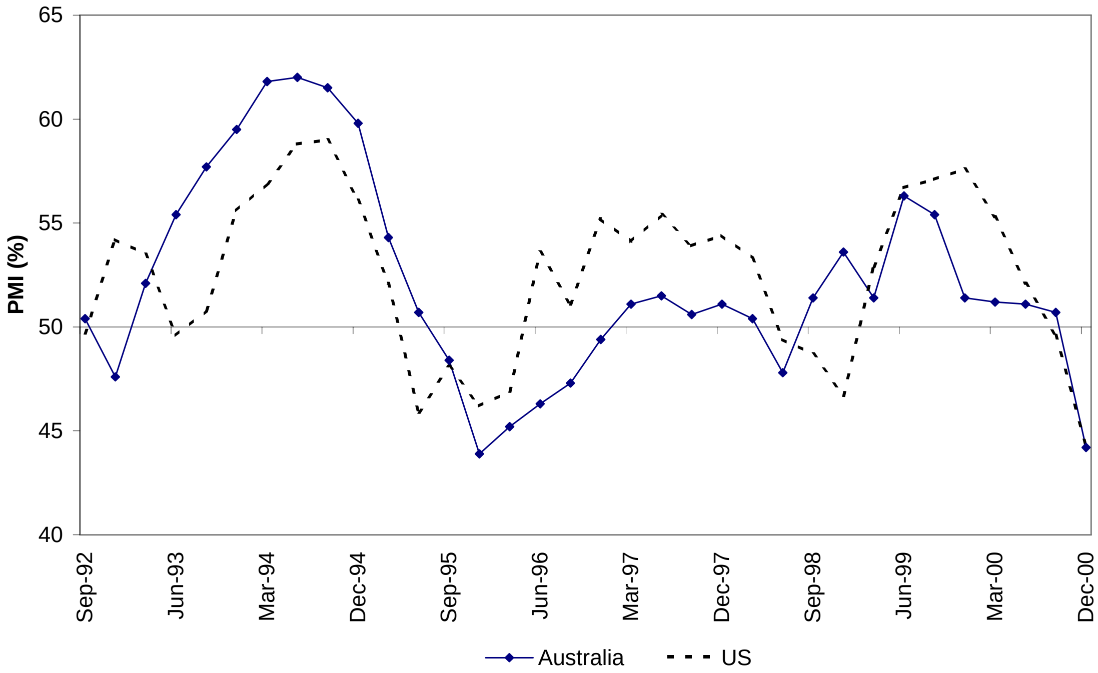
2.2. Relationship between NAPM-PMI and Ai-PMI

As is shown in Figure 4, over the last eight years there has been a striking correlation (0.63) between the PMI and the NAPM-PMI. It can be seen that the Ai-PMI is more volatile than its American counterpart (standard deviation 5.2 for the Ai-PMI versus 4.6 for the NAPM-PMI), but not significantly so. Most notably they have a very similar pattern. This common pattern is most likely due to manufacturing in both

[5] The growth cycle is the pattern of peaks and troughs observed in a series after a deterministic trend is removed.

countries being affected by a common factor. Interestingly, the graph seems to suggest that the Australian PMI is leading the US one, which would be consistent with the common factor being a world factor rather than a US factor that affects the rest of the world. Except for the episode in 1996, the Australian PMI reaches peaks or troughs at least one quarter before the U.S. PMI. The Australian manufacturing started to show signs of weakness in late 1999, while the American manufacturing still reported a strong expansion at that time.

Figure 4: PMI: Australia and the United States



It is worth exploring the relationship further using regression techniques. Table 1 reports the results from the regression of the Ai-PMI on the current value of the NAPM-PMI and 4 lags of the both PMI's.

Table 2 reports the regression of the Ai-PMI on its own lags only. We conclude that the current and lagged values of the NAPM-PMI are of little use in forecasting the Ai-PMI (F=0.76, P-value =0.59).

Table 1: Dependent Variable is Ai-PMI: VAR (4)

	Coefficients	*t statistic*	*P-value*
NAPM-PMI	0.21	0.83	0.41
NAPM-PMI(-1)	-0.19	-0.87	0.39
NAPM-PMI(-2)	-0.11	-0.50	0.62
NAPM-PMI(-3)	0.03	0.15	0.88
NAPM-PMI(-4)	-0.10	-0.46	0.65
Ai-PMI(-1)	0.94	4.26	0.00
Ai-PMI(-2)	-0.08	-0.26	0.80
Ai-PMI(-3)	0.36	1.17	0.25
Ai-PMI(-4)	-0.43	-1.90	0.07
constant	19.04	1.12	0.28

R^2	0.85
Adjusted R^2	0.79
Standard Error	2.34
Observations	30

Table 2: Dependent Variable is Ai-PMI: AR (4)

	Coefficients	*t statistic*	*P-value*
Ai-PMI(-1)	1.02	5.11	0.00
Ai-PMI(-2)	-0.16	-0.54	0.60
Ai-PMI(-3)	0.31	1.16	0.26
Ai-PMI(-4)	-0.49	-2.70	0.01
constant	16.30	2.92	0.01

R^2	0.83
Adjusted R^2	0.80
Standard Error	2.28
Observations	30

Table 3 and Table 4 report the corresponding regressions for the case where the NAPM-PMI is the dependent variable. Here we reject the hypothesis that the Ai-PMI is of no use in forecasting the NAPM-PMI (F=3.23, P-value=0.03). We interpret this result as suggesting that Australian manufacturing firms experience some world economic shocks that affect manufacturing one or two quarters before they are experienced by US firms.

Table 3: Dependent Variable is NAPM-PMI: VAR (4)

	Coefficients	*t statistic*	*P-value*
NAPM-PMI(-1)	0.30	1.63	0.12
NAPM-PMI(-2)	0.13	0.69	0.50
NAPM-PMI(-3)	-0.24	-1.32	0.20
NAPM-PMI(-4)	-0.40	-2.28	0.03
Ai-PMI	0.16	0.83	0.41
Ai-PMI(-1)	0.10	0.35	0.73
Ai-PMI(-2)	0.05	0.16	0.87
Ai-PMI(-3)	0.32	1.18	0.25
Ai-PMI(-4)	-0.35	-1.70	0.11
constant	49.19	4.46	0.00

R^2	0.83
Adjusted R^2	0.75
Standard Error	2.07
Observations	30

Table 4: Dependent Variable is NAPM-PMI: AR (4)

	Coefficients	*t statistic*	*P-value*
NAPM-PMI(-1)	0.68	3.84	0.00
NAPM-PMI(-2)	0.02	0.09	0.93
NAPM-PMI(-3)	-0.13	-0.61	0.54
NAPM-PMI(-4)	-0.41	-2.34	0.03
constant	44.29	4.47	0.00

R^2	0.66
Adjusted R^2	0.61
Standard Error	2.52
Observations	30

The analysis above while useful and indicative should be interpreted with some caution as it is based on a small number of observations (30 quarters).

2.3. Rules of thumb for reading the Ai-PMI

The strong empirical relationship between the NAPM-PMI and the Ai-PMI documented above suggests that one could use the rules of thumb discussed to read the implications of the Ai-PMI for the Australian business cycle.

Over the period for which the Ai-PMI is available these rules of thumb would have produced the following calls. First, a false call of classical cycle recession would have been made in December 1995 (the Ai-PMI had fallen by 18.1 points to that date). Second, the Ai-PMI would have called a growth cycle recession in March 1995 a little before the actual peak date of August 1995. It would have called a trough at March 1997, which is somewhat before the actual trough in August 1997. Most recently this rule would have called a growth cycle peak in December of 2000 whereas our best estimate now is that the peak occurred in early 2000. However, because of the transitional effects of the GST almost all analysts were late in calling the most recent growth cycle turning point.

Our preliminary assessment therefore is that the Ai-PMI is potentially a reliable and useful tool for signaling turning points in the Australian growth cycle. Although the sample period is short it seems that rules of thumb derived from the NAPM-PMI can be translated to Australia and over the sample period would have produced reliable and timely warnings of growth cycle slowdowns. In regard to the classical cycle more evidence is required before a preliminary assessment could be made. The Ai-PMI, using NAPM 14-point fall rule of thumb, has produced one false warning of recession in 1995. It is currently just 1.8 point away from calling another recession so it is possible that by mid 2002 there will be sufficient evidence to assess its ability to signal classical recessions in Australia. Our expectation is that, given its good performance in signaling growth recessions, the Ai-PMI will prove to be a useful tool to predict classical recessions. However, because such events are relatively rare it may take 10 to 15 years to accumulate the evidence to verify this expectation.

2.4. Ai-PMI and the ABS measure of manufacturing product

One problem faced by the Ai-PMI is that at first glance it does not seem to be very closely related to the ABS measure of manufacturing production. See Figure 5 below. The correlation between these two series is only 0.49. Inspection of Figure 5 reveals that the problem may lie with the ABS series which is implausibly volatile, suggesting that that agency may be having some difficulty in accurately identifying the quarter in which manufacturing production takes place. There is, however, a simple transformation of the data that brings out much more clearly the fact that the Ai-PMI and ABS manufacturing product are closely related. This is demonstrated in Figure 6, which plots the Ai-PMI against a 5-quarter centered moving average of the deviation of manufacturing production from a linear trend. It can be readily seen that the fit is much improved and the correlation between the two series has increased to 0.75. This finding supports the hypothesis that the ABS and respondents to the Ai Group survey are reporting the same information about manufacturing production but they are differing in regard to the quarter in which the production occurs. This finding suggests that improved estimates of manufacturing production might be made by combining the Ai Group and ABS data.

Figure 5: Ai-PMI and ABS manufacturing production (percent deviation from linear trend)

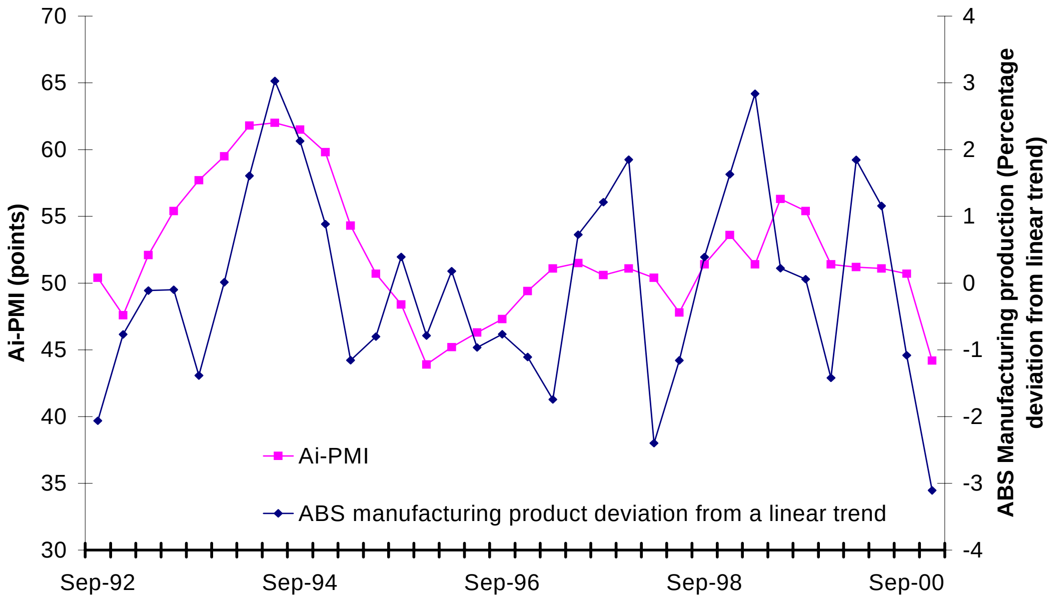
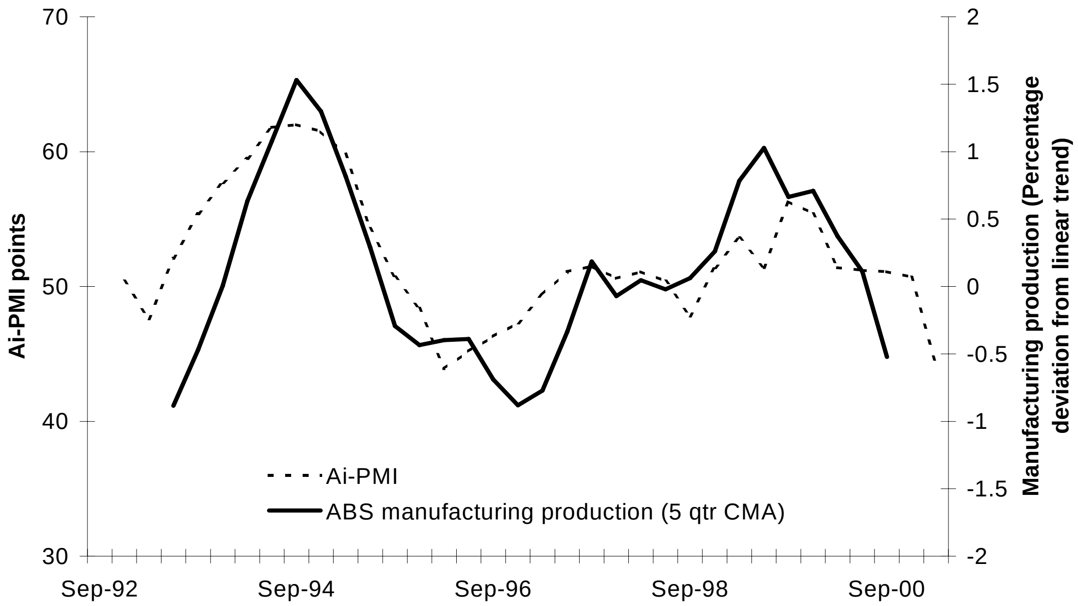


Figure 6: Ai-PMI and 5 quarter centred moving average of ABS manufacturing production (percent deviation from linear trend)

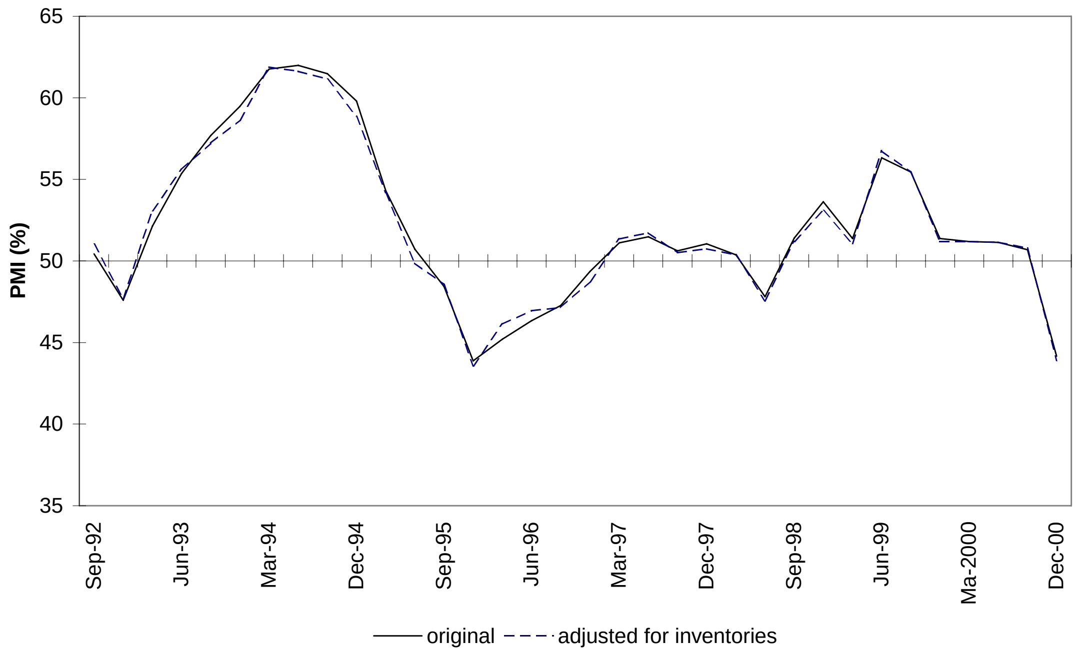


3. Alternative methods for constructing indices to measure manufacturing performance

3.1. Treating inventories as counter-cyclical

Since the indicator of inventories in the Ai-Group survey should be counter-cyclical, this leads us to question the procedure for constructing the PMI, which assigns a weight of 0.1 to the indicator of inventories. When firms report increasing inventories, it implies manufacturing activity may be going to decrease, but in the calculation of the PMI, higher inventories would raise the PMI. We therefore adjusted the PMI by using the percentage of firms reporting decreases in inventories plus half of the no change responses to make the adjusted series pro-cyclical. However, as can be seen from Figure 7 this change has a negligible effect on the Ai-PMI. The December quarter adjusted PMI reading, however, is changed to 43.9 per cent from the original 44.2 per cent, suggesting a somewhat more serious downturn in manufacturing and the economy.

Figure 7 PMI: adjusted to make inventories pro-cyclical

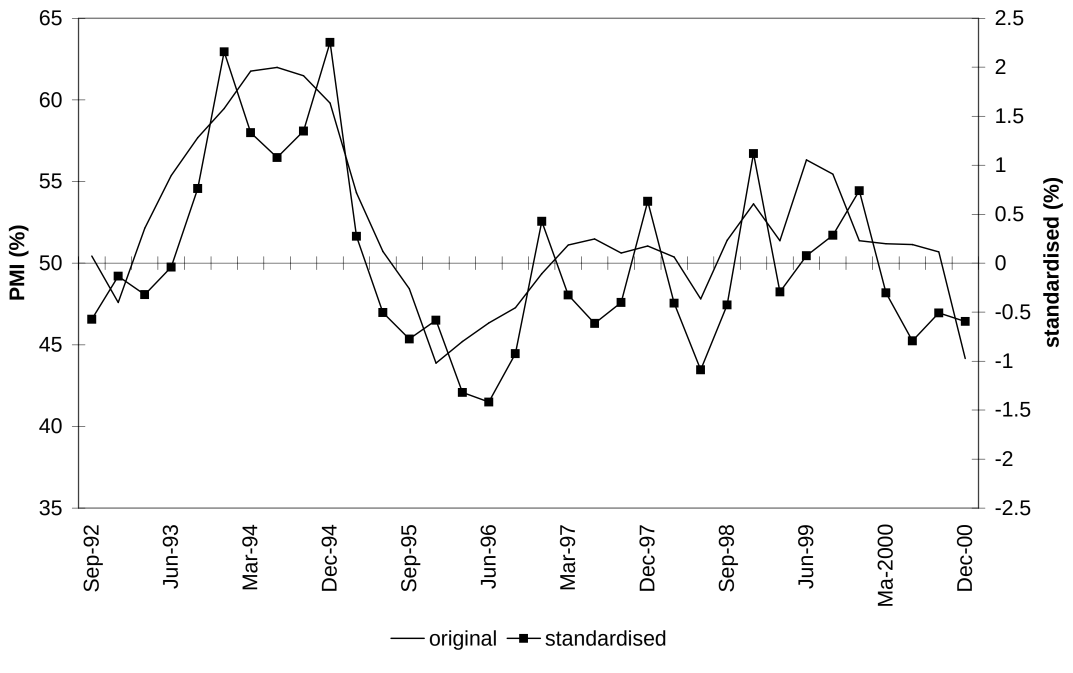


Adjusting for the counter-cyclical nature of inventories does not matter much in practice for two reasons. First, inventories are given a low weight in the Ai-PMI. Second, for inventories, there is a higher than 50 per cent no change responses in every quarter since 1992. This means that the Ai-Group inventory series has a low variance. This latter observation leads to the next proposed adjustment.

3.2. Standardising the component series

A basic statistical analysis shows that the diffusion indices that comprise the Ai-PMI have quite different volatilities. For example, the standard deviation of the diffusion index is 7.11 for production, 6.87 for new orders, 4.5 for employment and 2.0 for inventories. The more volatile series have a bigger impact on the variations in the Ai-PMI. This suggests that one may want to consider a PMI that is constructed by standardising each of the component series by its standard deviation. Figure 8 plots Ai-PMI (left scale) and the standardised PMI (using the right scale), which is based on the standardised diffusion indices (subtracting the mean from each diffusion index then divided by its standard deviation).

Figure 8: Ai-PMI and standardised PMI



Though the standardised one is highly correlated with the original one (0.81), the two have quite different patterns. The standardisation results in an index with longer leads as well as an index that is more volatile. In the recent economic slowdown, the standardised PMI dipped below zero in early 2000, while the original PMI was still showing a sign of expansion. Compared to the original one, the standardised one is able to anticipate the peaks earlier in the sample period. However, the additional volatility of the standardised PMI makes it somewhat more difficult to interpret.

Our **recommendation** is that the Ai-Group continue to calculate the PMI on the existing basis for the next 5 years and then reevaluate the issues of whether to:

- treat inventories a counter cyclical; and
- standardise the components of the index to reflect their relative volatilities.

There are several reasons for making these recommendations:

- It is useful to have the Ai-PMI comparable to the NAPM-PMI which we understand also treats inventories as pro-cyclical and does not standardise its component series to have unit variance;
- Because inventories have low weight and low volatility it does not matter much how they are treated;
- There is insufficient data to be sure which method works yields the best composite indicator.

3.3. Indices based on dynamic factor analysis

Coincident and leading indicators of economic activity are typically averages of time series and some criterion has to be established on how to weigh different components of the index. It was seen in the previous sub-sections that alternative weighting schemes would produce quite different indices. Moreover, one might want to weigh observations that are close in time thereby producing even more candidate indices. Thus a procedure is needed to choose between the various candidate indices. The method used in this section is based on the "generalised dynamic factor model" of Forni, Hallin, Lippi and Reichlin (2000), and Forni and Lippi (2000). The interested reader should consult these papers for technical details.

This model is a generalisation of the classical factor model and can be used to estimate large panels of time series. The model reconciles dynamic factor analysis with dynamic principal components and the estimator is constructed so as to take into account phase differences between time series by appropriately weighing leading and lagging variables. This feature allows estimating the model on all available variables

– leading, coincident and lagging – without needing to pre-classify them *a priori*. This method differs from previous literature, which defines the coincident indicator as a common factor extracted from an index model estimated on a small number of coincident variables which are identified, prior to estimation, by heuristic criteria. This method is able to take into account the cross-correlation, not only among the sub-components used in constructing the indices, but also the dynamic relationships across time.

3.3.1. Calculating procedure

The procedure captures the within-subcomponent as well as cross-subcomponent correlation structure. This section calculates two sets of coincident and leading indices. The first set of indices is based on the four key indicators for twelve manufacturing industries from the Ai Group's survey (48 variables in total), which are the same variables used to construct the PMI.[6]

The second set of indices takes the Ai-Group data above and adds to it the ABS data on manufacturing production and profits by industry. The sources of the ABS data are listed in Data appendix.

The steps used in the procedure, are:

1) Selecting variables that should be included in the panel of times series used to compute the index. Core variables are those must be used in computing the index. The non-core variables are those that have to be tested to decide if it should be included in the panel. In both cases the core variable is production. The remainders are non-core variables.

2) Converting those variables to stationary series with a mean of zero and a variance of one. The Ai Group data are already stationary and thus the mean is subtracted from each series and the demeaned series is divided by its standard deviation. The data from the ABS are assumed to be non-stationary (integrated of order one), thus each time series is first differenced, subtracted by its mean and divided by its standard deviation.

3) Calculating the composite coincident and leading indices and the sub-component coincident and leading indices:
   - Compute the cross and auto spectra of the common and the idiosyncratic components.
   - Using the spectra of the common components, compute the phase; indicating if the common factor of the variables is in phase or in opposition at frequency zero and the time lead at a certain frequency.
   - Compute the K-filter estimates of the common components of the panel of time series.
   - Leading variables are defined as those with time phase lead larger than one month (0.33 quarters); lagging variables are defined as those which lag by more than one month, and the remaining variables are defined as coincident.

3.3.2. Combining Ai-Group survey information to construct leading and coincident indexes for manufacturing

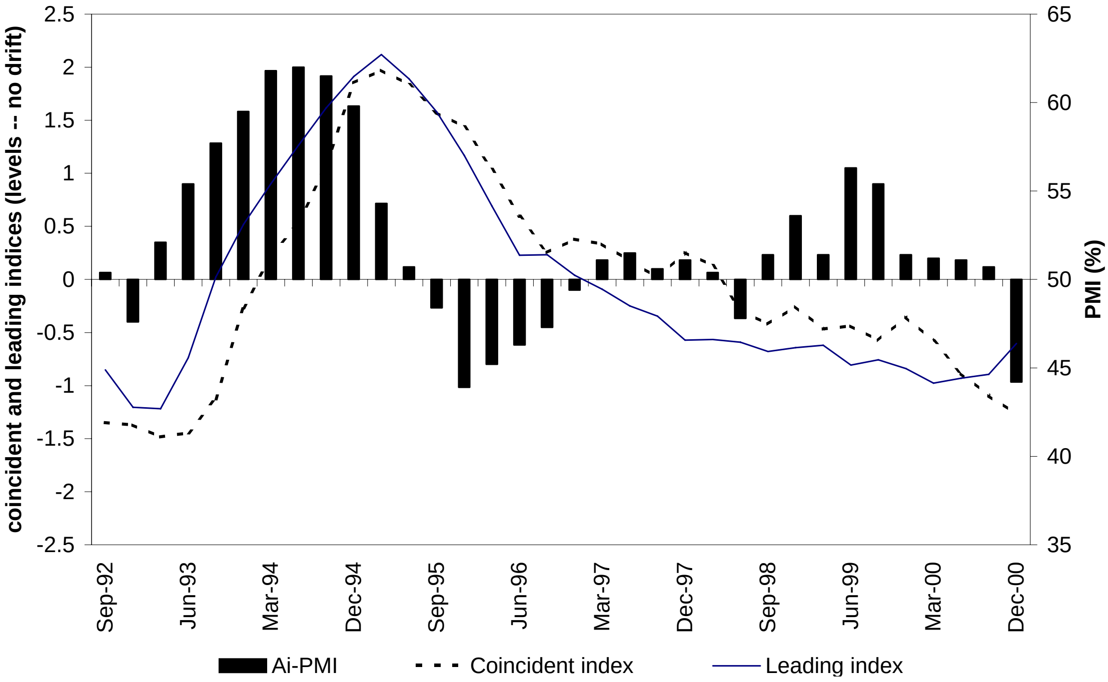
Figure 9 plots the first set of coincident and leading indices obtained from the new procedure, which is based on four key indicators across industries from the Ai Group's survey. While the Ai-PMI is based on *ad hoc* weights, it is clear that it is leading the newly constructed leading index in the early 1990s. However, the leading index, after peaking in early 1995, had been declining ever since and decreased to below zero in early 1997, implying that manufacturing performance was below the unconditional trend for some time.

The leading index, which is based on an optimal weighting scheme, might suggest that the responses from the manufacturing sector had showed weakness since the Asian financial crisis. The leading index is not able to pick up the mid-cycle pause in 1996 and a strong expansion in 1999. In this respect, the PMI may be better than the optimally weighted leading index. It is, however, important to highlight that the procedure used to construct the coincident and leading indices takes into account not only the cross-correlation across the industries but also the correlation across time, whereas the procedure applied by the Ai Group ignores these cross-correlations.

[6] Since the indicator of deliveries was added in late 1998, this indicator is not included in the new

The leading index constructed via the dynamic factor approach supports the view that Australian manufacturing activity may be weaker in recent times than is suggested by the Ai-PMI. That is the dynamic factor approach may be able to extract more information from the data set.

Figure 9 Ai-PMI and the first set of coincident and leading indices

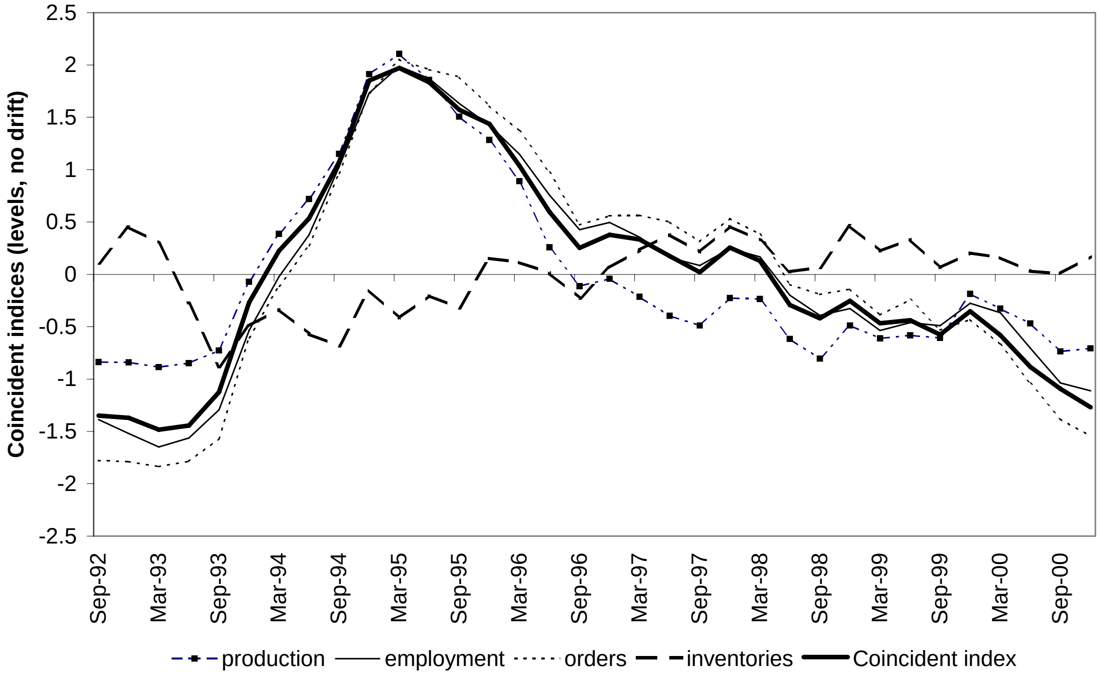


Sub indexes by activity type

It is possible to construct sub-component indices based on each indicator. Figure 10 shows the four sub-components used in calculating the coincident index in Figure 9. The results suggest that the indicators for production, employment and orders are very close to each other and the composite coincident index follows the trend of these three indicators. However, the indicator for inventories is clearly counter-cyclical and possibly leading others. This is consistent with economic theory and should be considered in constructing the PMI (also see the PMI adjusted for inventories suggested above).

indices due to lack of the historical series.

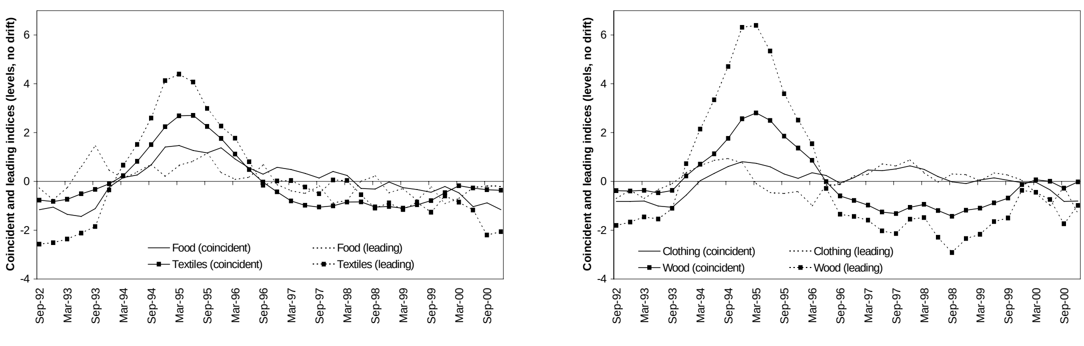
Figure 10 Coincident index (first set) sub-components: indicators

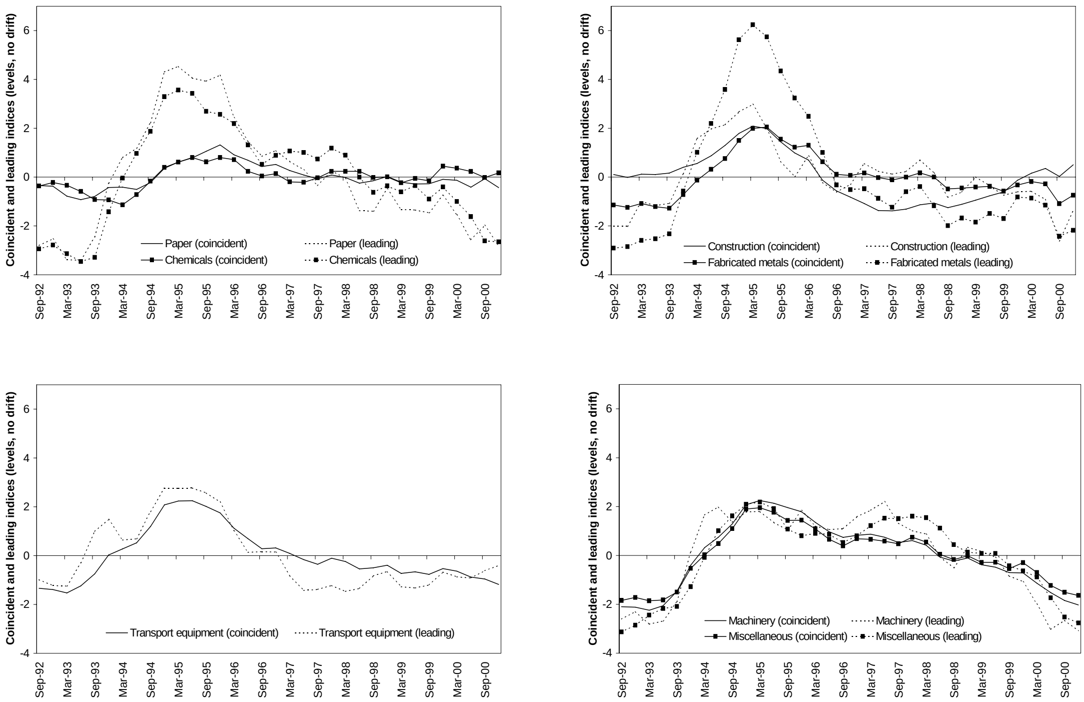


Sub indexes by industry type

It is also possible to construct sub-components of the coincident and leading indices across industries, which are shown in Figure 11. It can be seen that they are quite similar though some are more volatile, such as wood and fabricated metal industries. Paper and textile industries are lagging one quarter behind other industries.

Figure 11 Coincident and leading index (first set) sub-components: industries





3.3.3. Combining Ai-Group survey information with ABS data to construct leading and coincident indices for manufacturing

The second set of coincident and leading indices are based on the combined data set from the Ai Group's survey and the ABS data on manufacturing production and profits by industry, shown in Figure 12, along with the Ai-PMI in the period 1992-2000.[7]

As is in the previous sub-section, the obtained coincident and leading indices are different from the Ai-PMI. The indices that combine Ai-Group and ABS information show a declining trend after early 1995 and are below zero in early 1998. The graph, however, shows that since late 1996, the leading index has been more volatile than the coincident index, while the two indices indicate weakening manufacturing activity. The volatility of the leading index is possibly due to the ABS data on profits for several industries. For example, the metal product industry suffered a significant net loss in the June quarter of 1999 while it had a similar amount of profits in the quarters before and after the date. It was the same case in the first half of 2000 for the metal

[7] To make the Ai Group and ABS data comparable, the industries are re-grouped into following eight categories: food, beverages and tobacco; textile, clothing and footwear; wood, paper products, printing, publishing and recorded media; petroleum, coal, chemical and etc; non-metallic mineral products; metal products; machinery and equipment; and other manufacturing.

product industry. The finding is consistent with the conclusion reached when we compare the Ai-PMI and manufacturing product growth reported by the ABS, that the ABS has difficulties in identifying the time manufacturing production occurs. Thus we conclude that there is little in practice to gain by combining Ai-Group and ABS information on manufacturing until the quality of the ABS data can be improved.

Figure 12 Ai-PMI and coincident and leading indices (combining Ai-Group and ABS information)

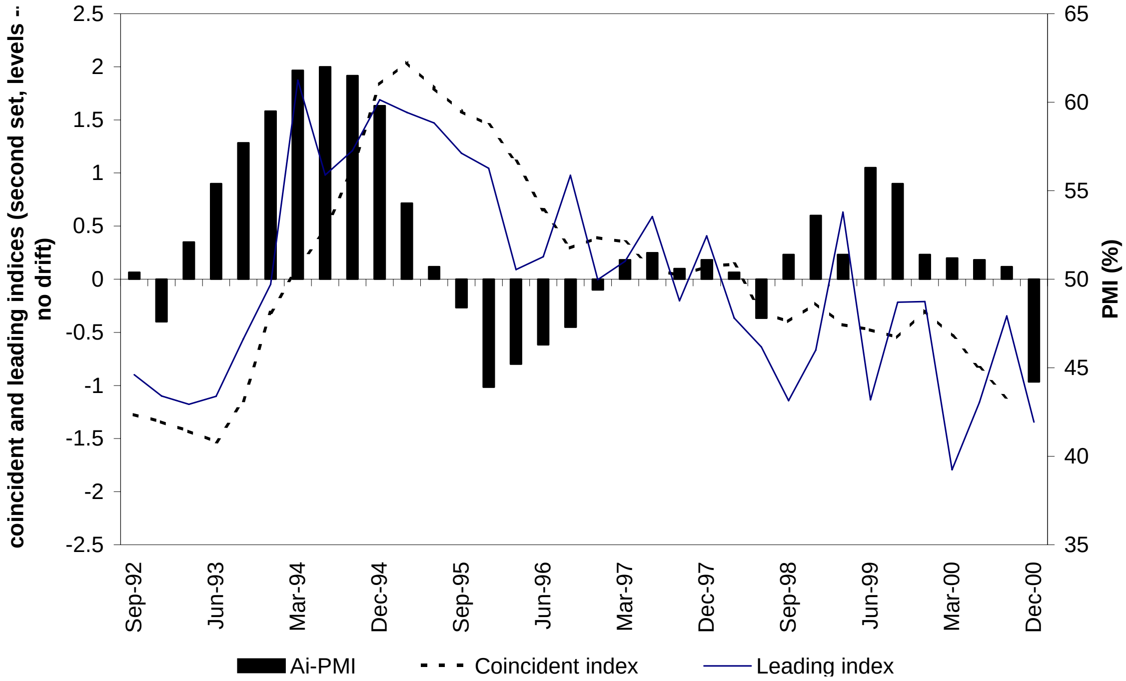
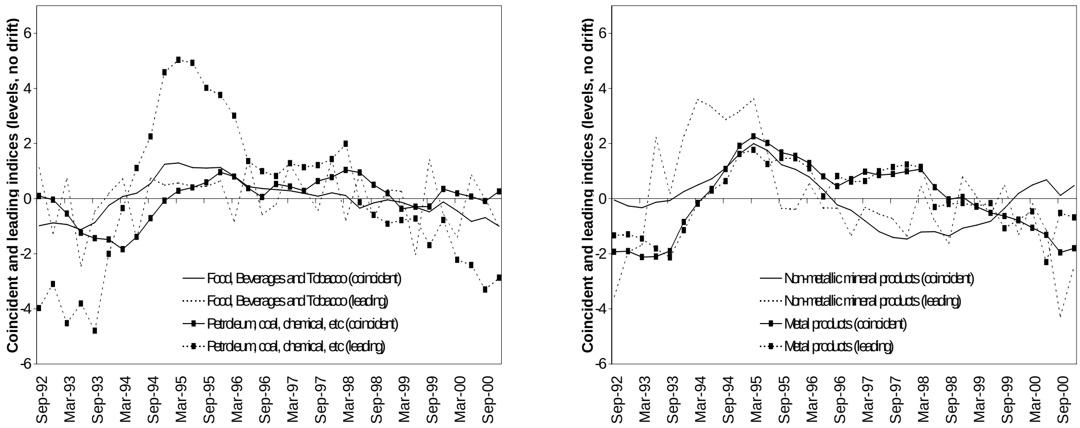


Figure 13 plots the sub-components of the indices for selected industries. It shows that the industries of the food, beverages and tobacco and non-metallic mineral products have quite volatile leading indices. The graph seems to suggest that the industry of petroleum, coal, chemical and etc is leading others.

Figure 13 Coincident and leading index sub-components: selected industries



4. Ai-PMI and aggregate economic activity

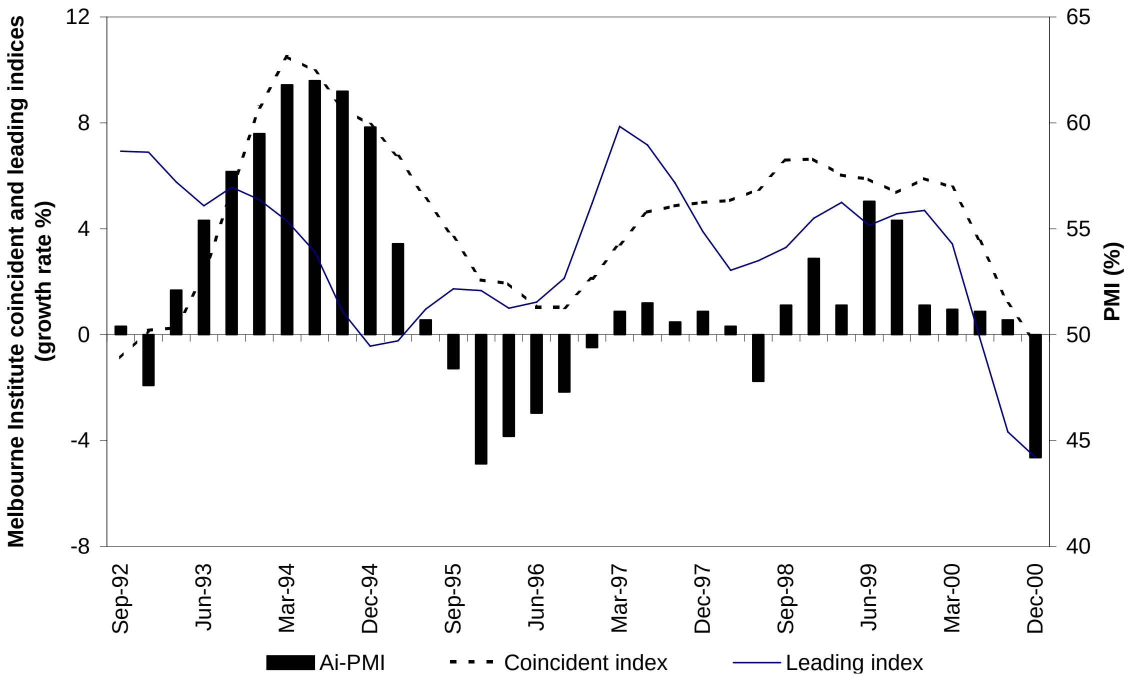
The previous section compares the Ai-PMI with the indices based on alternative weighting schemes. However, the data used in the previous section are basically the data of manufacturing activity. The second section has addressed the rules of thumb to read the implications of the Ai-PMI for the Australian business cycles, but the section is based on the relationship between the NAPM-PMI and the American business cycle. It is interesting to see whether there is a relationship between the Ai-PMI and Australian aggregate economic activity. This section further examines the Ai-PMI and attempts to compare the Ai-PMI with the indicators of the Australian economy. The indicators chosen in this section are the coincident and leading indices complied by the Melbourne Institute, and reported monthly in *Westpac-Melbourne Institute Indexes of Economic Activity*.

The Melbourne Institute coincident index is a weighted average of six economic series: real retail sales, civil employment, the unemployment rate, real gross non-farm production, real household income and real industrial gross production. The coincident index reduces the extent to which measurement error in preliminary data distorts the reading of the current state of the economy and provides a truer reading of the state of the economy than do any of the alternative measures.

The Melbourne Institute leading index is a weighted average of nine economic series: non-residential building approvals, residential building approvals, new telephone connections, share prices, overtime worked, real profits, real unit labour costs, real money supply and manufacturing materials prices. In using the leading index to predict future economic activity, particular attention is paid to the growth rate of the index. Deviations from the trend growth rate of the leading index allow a relatively clear reading of the business cycle.

Further information on the Melbourne Institute coincident and leading indices can be found in Boehm and Moore (1984) and Appendix B of Report No. 122 (August 23, 1985), *Melbourne Institute Indexes of Economic Activity.*

Figure 14 Ai-PMI and Melbourne Institute coincident and leading indices



The Melbourne Institute coincident and leading indices, as well as the Ai-PMI, are plotted in Figure 14. The graph shows that the leading index is good at predicting turning points in the economy, which are represented by the coincident index. The coefficient of correlation between the coincident index and the one-and-half-year-ahead leading index is 0.64.[8] Except for the recent decrease in the coincident index,

[8] Over the period 1980-2000, the coefficient of correlations between the coincident index and the two to three quarter ahead leading indices are all above 0.80.

the leading index is able to anticipate and identify the turning points in economy activity from 1992 to 2000.[9]

It is found that the Ai-PMI is much closer to the coincident index than to the leading index. The coefficient of correlation is 0.80 between the Ai-PMI and the coincident index and 0.19 between the Ai-PMI and the leading index. The Ai-PMI was able to identify the growth recession in 1996 by at least one quarter in advance. However, the Ai-PMI did not anticipate the peaks in 1994 and in mid 1999. Actually, the Ai-PMI had almost the same turning points with the coincident index. The Ai-PMI indicated the weakness of manufacturing in the wake of the Asian financial crisis, though the coincident index (and the leading index) did not show any sign of weakness in the economy. Similar to the coincident index, the Ai-PMI showed the strength of manufacturing in mid 1999 when it reached the peak after 1994.

In the December quarter of 2000, the Ai-PMI declined to 44.2 per cent, from 50.7 per cent in the previous quarter. The Ai-PMI does anticipate the current economic slowdown starting from mid 2000. It is not until March 2001 when it was known the economy was shrinking in the December quarter of 2000.

Compared with the Melbourne Institute coincident and leading indices, the Ai-PMI has similar turning points with the coincident index, and is much closer to the coincident index than to the leading index.

5. Conclusion and recommendations

This paper has examined the Ai-PMI as a tool of analysing cyclical trends in economic activity, and manufacturing activity in particular. Although the sample period is short, it seems that rules of thumb derived from the NAPM-PMI can be translated to Australia and over the sample period would have produced reliable and timely warnings of growth cycle slowdowns. Our preliminary assessment therefore is that the Ai-PMI is potentially a reliable and useful tool for signaling turning points in the Australian growth cycle. In regard to the classical cycle more evidence is required

[9] For a detailed analysis of Australia's business cycles after World War II, see Boehm and Summers

before a preliminary assessment could be made. The conclusion is reinforced by the high correlation between the Ai-PMI and the coincident index of economic activity complied by the Melbourne Institute. We found that the Ai-PMI is highly correlated to the 5 quarter centered moving average of the ABS measure of manufacturing product growth. Our reading of this is that the ABS may be having some difficulty in locating the exact quarter in which manufacturing activity occurs and that the Ai-PMI may give a clearer reading of when activity occurs.

We experimented with several alternative methods of constructing indicators from the Ai-group data. We find some minor problems with the method of constructing the PMI. However, these problems are shared by the NAPM-PMI and thus our **recommendation** is that in order to maintain comparability the Ai-group would be best served continuing with the current methodology. However, we note that the dynamic factor approach does seem to capture information that is in the Ai-Group data but which is not captured in the PMI. Thus, we **recommend** keeping a watching brief on whether the dynamic factor approach might ultimately be superior. If the quality of ABS data on manufacturing could be improved then, the approach of using the dynamic factor model to combine the Ai-Group data with the ABS data would prove to be very powerful.

(1999).

Data appendix

ABS time series used in Section 3:

1) Company profits before income tax ($ Millions), manufacturing. Table 6. 5651.0
2) Industry gross value added, chain volume measures ($m). Table 48. 5206

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