

# Correlations of Ai Group Performance Indices with Official Economic Data

## Introduction

A number of countries use Performance of Manufacturing/Services/Construction indices as indicators to assess the direction and pace of the national economy in a timelier manner than allowed by national statistical agencies' official data.

In Australia's case, where manufacturing makes up around 9% of GDP, the services sector around 60% of GDP, and the construction sector 7% of GDP, the Australian indexes, a priori, should have considerable usefulness in assessing the state of the economy and business cycle and in making some prediction about near-term developments.

This note assesses the extent of correlation between Ai Group's performance of manufacturing, services and construction indices and overall economic activity measured by quarterly and annual GDP (A) growth and sectoral performance as measured by GDP (P) (manufacturing, services and construction).

The analysis updates that carried out by the Reserve Bank of Australia in 2003 and the results are in line with those included in recent discussions between the Ai Group Economics and Research Unit and RBA officials, which suggest a solid correlation between annual rates of growth in most economic indicators and the indices, but only weak correlations with quarterly outcomes.

The analysis below compares quarterly averages of the indices with contemporaneous through-the-year annual growth rates and quarter on quarter growth rates.

## Results

### The PMI

Judging by simple correlation coefficients, set out in Table 1, over the full data series since 1991 the relationship between both annual and quarterly ABS measures of GDP growth and the PMI has been only modest.

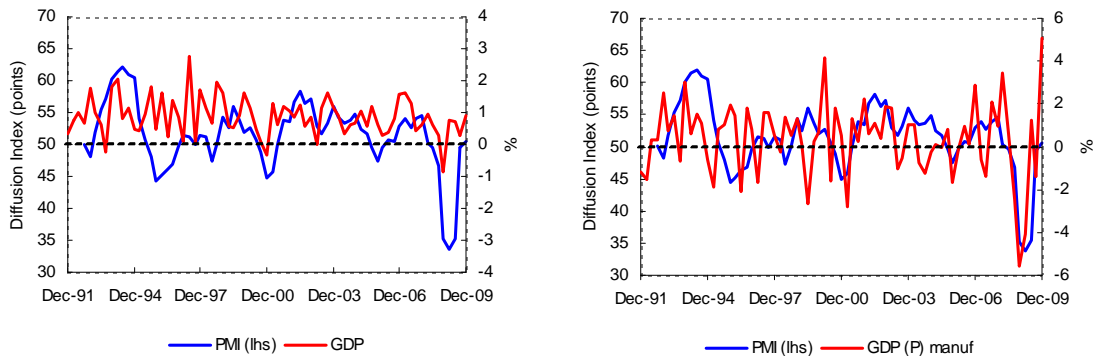
**Table 1: Correlation of national PMI with various measures of output growth**

	Annual Growth			Quarterly Growth		
	GDP	GVA	GDP(P) manufacturing	GDP	GVA	GDP(P) manufacturing
Correlation since 1991	0.58	0.54	0.56	0.26	0.29	0.34
Correlation since 2001	0.74	0.67	0.72	0.38	0.56	0.58

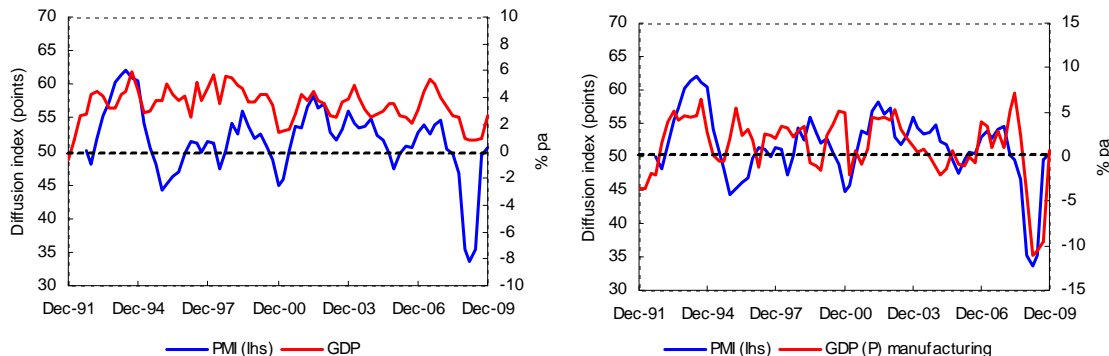
However, from the early 2000s there has been a more solid correlation in terms of annual growth rate measures, suggesting an improved predictive capacity for the forthcoming quarterly outcome for annual growth. The strength of the relationship with measures of quarterly growth remains modest.

Charts 1 and 2 illustrate the increasing correlation as time has elapsed.

**Chart 1: Australian PMI and Annual GDP and Manufacturing GDP (P) growth**



**Chart 2: Australian PMI and Quarterly GDP and Manufacturing GDP (P) growth**



### Why has the correlation between the PMI and growth measures improved?

One reason for the closer relationship between the PMI and growth measures is likely to be that the economy has been more stable, particularly since the late 1990s. The major elements of this stability are that economic growth and macroeconomic policy have been more predictable for companies. The absence of destabilising shocks has meant that the element of confidence/psychology that contributes to a perceptions based indicator such as the PMI has, until recently, become more stable meaning that company perceptions of activity are not clouded by uncertainties facing the national economy and macroeconomic policy and are therefore more reflective of actual economic conditions.

The severe shocks to confidence seen in the wake of the collapse of Lehman Brothers in September 2008 were reflected in a sharp drop in the PMI. While this has not been reflected in a similarly precipitous drop in overall GDP (P) growth – likely due to the relative smallness of the sector and

rapid aggregate policy responses by the Reserve Bank and Federal Government - the link between the PMI and measures of annual and quarterly growth in manufacturing GDP (P) has been close – i.e. the fall in manufacturing output has been similarly strong.

In the latter case, manufacturers appear to have foreseen the implications of a sharp decline in global manufactures trade, though the ongoing, and magnified in a downturn, impacts of price factors such as import competition and the high level of the Australian dollar for the sector as a whole are also probable causes of the sharp downturn in sentiment and sectoral activity.

Increased frequency and sample size also likely have boosted the predictive ability of the PMI.

### PMI sub-components

The sub-components of the index, with the exception of employment which is on par and inventories which are significantly lower, show slightly lower levels of correlation with annual growth in official indicators since 2001 than the overall PMI. Table 2 also shows quarterly correlations are modest.

**Table 2: Correlations between PMI sub-components and various measures of output growth post 2001**

	Annual Growth			Quarterly Growth		
	GDP	GVA	GDP(P) manufacturing	GDP	GVA	GDP(P) manufacturing
Production	0.68	0.62	0.68	0.36	0.51	0.50
New Orders	0.66	0.58	0.64	0.44	0.58	0.56
Inventories	0.55	0.57	0.60	0.28	0.33	0.20
Deliveries	0.70	0.72	0.76	0.28	0.50	0.40
Employment	0.75	0.69	0.72	0.38	0.51	0.48
Overall PMI	0.74	0.67	0.72	0.38	0.56	0.58

Interestingly, in terms of quarterly growth, the new orders sub-component shows a moderately higher (though still modest) correlation with GDP growth than the overall PMI.

### PMI industry sub-sectors

Again, judging by some simple correlation analysis, the indexes for most of the PMI industry sub-sectors appear to hold a modest amount of information on likely trends in official data. As Table 3 shows, only a few sector indices have any significant correlation with national account measures of activity on average and for individual sectors. Again the correlation of the indices with annual growth is stronger than with quarterly growth rates.

**Table 3: Correlations between PMI sectoral indices and GDP growth**

	Food, beverage and tobacco products	Textile, clothing and other manufacturing	Wood and paper products	Printing and recorded media	Petroleum, coal, chemical and rubber products	Non-metallic mineral products	Metal products	Machinery and equipment
Annual	0.33	0.43	0.81	0.54	0.58	0.62	0.72	0.69
Quarterly	0.16	0.19	0.49	0.42	0.25	0.49	0.36	0.45

Positively in terms of overall alignment of the PMI with economic theory, those manufacturing sub-sector indices linked with the investment cycles which tend to drive overall business cycles in Australia, for example machinery and equipment or housing investment cycles, tend to be those most highly correlated with national accounts GDP growth data - wood and paper products; metal products and machinery and equipment.

Similarly, those manufacturing sub-sector indices tied to staples consumption which cycles less than the investment components of GDP, such as housing and business investment, are less correlated with GDP growth (Table 4). These sectors include 'staples' producers like food, beverages and tobacco and textiles and clothing.

**Table 4: Correlations between PMI sub-sectoral indices and national accounts measure of manufacturing growth**

	Food, beverage and tobacco products	Textile, clothing and other manufacturing	Wood and paper products	Printing and recorded media	Petroleum, coal, chemical and rubber products	Non-metallic mineral products	Metal products	Machinery and equipment
Annual	0.43	0.39	0.76	0.48	0.53	0.61	0.65	0.72
Quarterly	0.22	0.64	0.53	0.22	0.33	0.63	0.52	0.50

Table 5 illustrates again that the PMI indices of sectors with more pronounced cyclical behaviour are more correlated with the overall cycle in manufacturing sector data.

**Table 5: Correlations between PMI sub-sectoral indices and the national accounts measures of sub-sector growth**

	Food, beverage and tobacco products	Textile, clothing and other manufacturing	Wood and paper products	Printing and recorded media	Petroleum, coal, chemical and rubber products	Non-metallic mineral products	Metal products	Machinery and equipment
Annual	0.13	0.21	0.53	0.64	0.50	0.13	0.25	0.51
Quarterly	0.10	0.16	0.12	0.13	0.08	0.17	0.25	0.43

Overall, the correlations between the PMI sub-sector indices and national accounts sectoral equivalents are low, with annual correlations again higher than those for quarterly growth data.

The sectors with highest correlations between the PMI based sub-sector indices and national accounts equivalents are printing and recorded material, wood and paper products and machinery and equipment.

## The PMI employment sub-component and official employment data

**Table 6: Correlations between national PMI employment and official manufacturing employment levels and growth data**

	Employment Level	Annual Growth	Quarterly Growth
Correlation since 1991	0.40	0.38	0.20
Correlation since 2001	0.31	0.44	0.23

Table 6 shows the correlation between the PMI and measures of employment levels and growth are modest.

## The PSI

As with the PMI, there has been a reasonable correlation between the PSI and national accounts annual growth rate measures. The strength of the relationship with measures of quarterly growth is relatively moderate (Table 7).

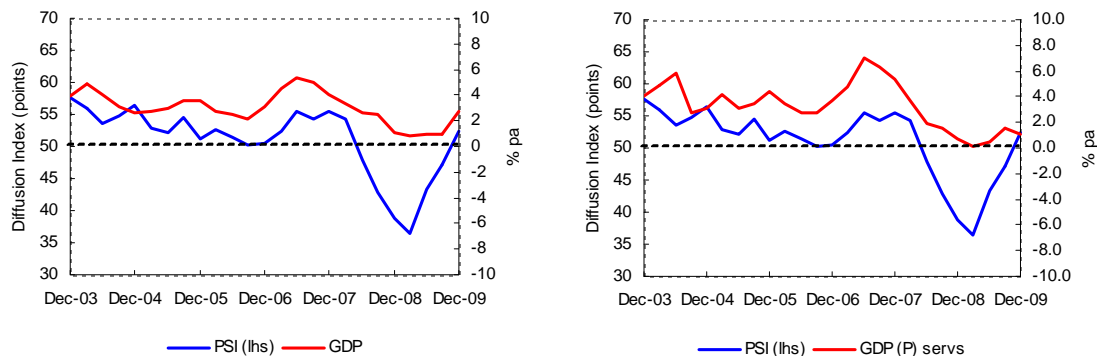
**Table 7: Correlations between national PSI and various measures of output growth**

	Annual Growth			Quarterly Growth		
	GDP	GVA	GDP(P) services	GDP	GVA	GDP(P) services
Since inception in 2003	0.74	0.60	0.72	0.52	0.62	0.38

Interestingly the PSI saw a similar sharp fall in the aftermath of the Lehman Brothers collapse as occurred in the case of the PMI. However, in contrast with the manufacturing sector, the services sector saw no significant fall in economic activity. This difference highlights the important role played by economic policy in breaking the link between dramatic falls in sentiment and economic activity outcomes but also that the services sector is not as subject to other strong, additional, pressures affecting manufacturing, including competition from low-labour cost manufactures and the high Australian dollar exchange rate.

The fact that the services sector did not see a sharp drop in economic activity, notwithstanding a collapse in the PSI, suggests that the sentiment component of the survey underlying the index is non-linear – that is it is amplified at times of uncertainty. If policy responses are effective and underlying activity is responsive this suggests that, in times of high levels of uncertainty, predictions of economic data using PSI readings will overshoot actual economic outcomes.

**Chart 3: Australian PSI and Annual GDP and Services GDP (P) growth**



## PSI sub-components

As Table 8 overleaf shows, the employment sub-component of the index shows slightly higher levels of correlation with annual growth in national accounts indicators since 2003 than the overall PSI. The

new orders component shows a relatively weak correlation, while those for sales, inventories and deliveries are roughly comparable.

**Table 8: Correlations between PSI sub-components and various measures of output growth post 2003**

	Annual Growth			Quarterly Growth		
	GDP	GVA	GDP(P) services	GDP	GVA	GDP(P) services
Sales	0.73	0.52	0.66	0.56	0.61	0.33
New Orders	0.65	0.49	0.58	0.52	0.58	0.34
Inventories	0.73	0.52	0.66	0.56	0.61	0.33
Deliveries	0.74	0.60	0.72	0.47	0.59	0.36
Employment	0.77	0.70	0.76	0.37	0.62	0.31
<b>Overall PSI</b>	<b>0.74</b>	<b>0.60</b>	<b>0.72</b>	<b>0.52</b>	<b>0.62</b>	<b>0.38</b>

Interestingly, in terms of quarterly growth the sales and inventories sub-components show a moderately higher (though still modest) correlation with GDP growth than the overall PSI.

### PSI industry sub-sectors

**Table 9: Correlations between PSI sectoral indices and GDP growth**

	Wholesale trade	Retail trade	Accomm, cafes & restaurants	Transport & storage	Comm. services	Finance & insurance	Property & business	Health & community services	Personal & recreational services
Annual	0.65	0.71	0.75	0.71	0.71	0.50	0.76	0.55	0.41
Quarterly	0.51	0.50	0.50	0.33	0.54	0.31	0.53	0.36	0.20

The services sub-sectors indices linked to consumer spending show a significant correlation with national accounts measures of GDP. The sub-sector index most closely influenced by discretionary, as opposed to staple, consumer spending, accommodation, cafes and restaurant is solidly correlated with GDP growth (Table 9).

The property and business services sector index is also relatively robustly correlated with GDP growth, largely reflecting the close association of the housing investment cycle with movements in the overall economy and the interest rate cycle.

### The PSI employment sub-component and official employment data

**Table 10: Correlations between national PSI employment and official services employment levels and growth data**

	Employment Level	Annual Growth	Quarterly Growth
Correlation since 2003	-0.5	0.6	0.2

Correlations between the PSI and measures of levels of services sector employment and quarterly growth are minimal (negative in the case of levels) and moderate in the case of the annual growth rate in services sector employment (Table 10).

## The PCI

Table 11 indicates correlations between the PCI and aggregate annual measures of economy wide activity are reasonable. However, Table 12 shows correlations between the PCI and construction sector employment and quarterly growth are minimal (negative in the case of levels) and small in the case of the annual growth rate in services sector employment.

**Table 11: Correlations between national PCI, its components and various measures of output growth**

	Annual Growth			Quarterly Growth		
	GDP	GVA	GDP(P) construction	GDP	GVA	GDP(P) construction
Sales	-0.02	-0.24	-0.18	-0.37	-0.27	-0.30
New orders	0.08	0.13	0.39	-0.16	0.04	0.05
Employment	-0.10	0.05	0.33	-0.25	0.03	0.11
Deliveries	-0.40	-0.39	-0.27	-0.53	-0.55	-0.38
<b>Overall PCI</b>	<b>0.63</b>	<b>0.53</b>	<b>0.25</b>	<b>0.41</b>	<b>0.72</b>	<b>0.26</b>

## The PCI employment sub-component and official employment data

**Table 12: Correlations between national PCI employment and official services employment levels and growth data**

	Employment Level	Annual Growth	Quarterly Growth
Correlation since 2005	-0.5	0.2	0.2

## Why the PMI/PSI/PCI do not fully explain movements in the national accounts indicators

There are a number of reasons why the PMI/PSIs do not always and consistently predict changes in GDP measures:

**Measuring different things:** The national accounts measures are value added in production measures of output. The indices are a composite of a range of 'activity' variables: output (sales for PSI and PCI), employment, new orders, supplier deliveries and inventories. PMI/PSI/PCI components may move with different lags and in different directions at a point in time in comparison with the production measures of the national accounts.

For example, rises in inventories are seen as an increase in activity in the PMI/PSI. By contrast, a rise in inventories in a quarter has to be greater than the rise in the last quarter, otherwise it detracts from output in the national accounts measure of expenditure based GDP.

**Recognition differences/lags:** Given that the PMI/PSI are an amalgam of company perspectives and also reflects confidence/and psychological factors, it may be the case that the impact of aggregate factors, notably policy changes in response to changing economic conditions, have an impact on economic activity in the aggregate well before they are recognised at the individual firm level.

The index, in common with those measuring activity in overseas economies, is generally accepted as being partly a 'sentiment' indicator, answers to survey questions are therefore subjective, and may not always relate to events as much as perceptions.<sup>1</sup> Given, as Keynes pointed out, that 'animal spirits' relate to business psychology at a particular time in a business cycle, it may be the case that at times of severe current or potential economic conditions firms' confidence may respond in a non-linear way, (as per exchange rate overshooting vis Dornbusch) making stronger negative responses to questions more likely, though which may not translate into actual outcomes.

## Conclusion

Overall, the correlation analysis described above suggests that there is a reasonable correlation between the indices and the national accounts data for annual GDP growth. However the correlation between the indices and quarterly growth outcomes are only modest.

Within the sub-components of the PMI and PSI (the PCI tends to have minor correlation with activity data), the employment sub-component tends to display the strongest correlation with annual GDP growth data (though has negligible correlation with employment data). At a sub-sector level the cyclical sector indexes tend to be more highly correlated with the overall GDP growth data. This is unsurprising since the investment cycles in the economy tend to drive both cycles in aggregate economic activity and activity in these sectors.

The outcome that correlations are strongest with annual data raises the question, how are the respondents answering the questions set out in the survey? As the RBA has suggested, the responses may reflect a judgement on the survey month's outcomes relative to some form of trend or performance last year, rather than in relation to the previous month.

This may reflect operational data lags, lack of knowledge of recent outcomes across components of the index or the operational responsibilities of the person responding to the survey.

Overall, there is little significant correlation between the indices and quarterly growth rates. This indicates that while the indices have been solid performers in terms of giving some qualitative indications of turning points and the sub-sectoral make-up of, and divergences in, intra-sector performance, this does not suggest a ready translation between index outcomes and point forecasts of developments in the economic data.

### Contact

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<sup>1</sup> See details on the Institute of Supply Management website and RBA research paper '*Business Surveys and Economic Activity*' by Chris Aylmer and Troy Gill, February 2003.