

How does the Australian PMI® compare to ABS data?

This research note examines the statistical relationship between the Australian Industry Group Australian Performance of Manufacturing Index (**Australian PMI®**) and various ABS data series that are relevant to manufacturing activity. It updates a similar note published in 2014.

The findings demonstrate a strong relationship between the **Australian PMI®** and ABS data relating to manufacturing. On some indicators, a greater degree of divergence is apparent during 2016 and early 2017 than in the past. This appears to be due to the effects of the decline and exit of automotive assembly (passenger cars) on aggregate output and sales volumes, but not on all other indicators, during this period.

Ai Group has compiled and published Australia's leading performance index for the manufacturing industry, the **Australian PMI®** since 1992. The **Australian PMI®** is compiled from a monthly survey of manufacturing businesses that represent all manufacturing sub-sectors operating across Australia. The headline **Australian PMI®** is a 'diffusion' index, calculated from a weighted composite of five key activity indicators including production, new orders, supplier deliveries, inventories and employment. The weights for each sub-sector are derived from Australian Bureau of Statistics (ABS) data. The data are then seasonally adjusted and trended using the same statistical methodology as the ABS.

A monthly index result in the **Australian PMI®** above 50 points indicates that activity is, on balance, expanding; below 50, that it is declining, relative to the previous month. The distance from 50 points indicates the strength of the expansion or decline. For each question, survey respondents are asked to specify whether their activity for that indicator (e.g. new orders) has either increased ("up"), decreased ("down") or remained the same ("no change") from the previous month's level.

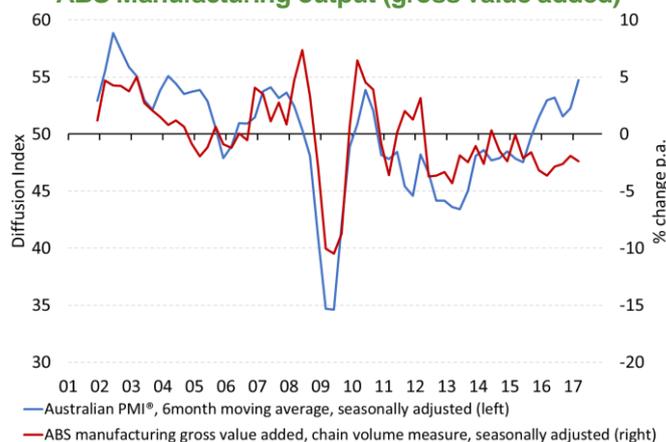
The relationship between the **Australian PMI®** and the ABS data is strongest for ABS annual growth rates rather than for quarterly or monthly movements in the ABS data. In most cases this relationship appears to be concurrent, but the earlier release date for the **Australian PMI®** gives it a 'lead' on the ABS data, even where the statistical relationship appears to be wholly concurrent.

Our research has found correlations for a number **Australian PMI®** activity sub-index series in addition to the headline results, including:

- the **Australian PMI®** headline index and annual growth in ABS manufacturing **gross value added (GVA)** and **nominal sales**;
- the **Employment** sub-index and annual growth in ABS manufacturing **employment** and **hours worked**;
- the **Export** sub-index and annual growth in ABS manufacturing **export volumes** and the RBA end-of-month **Australian dollar trade weighted index**;
- the **Wages** sub-index and annual growth in ABS manufacturing **Wage Price Index (WPI)**;
- the **Input Prices** sub-index and annual growth in ABS manufacturing **input prices**;
- the **Selling Prices** sub-index and annual growth in ABS manufacturing **output prices**; and
- the Capacity Utilisation sub-index and the ABS manufacturing multifactor productivity index (MFP).

These relationships are examined in the charts and text below. Their statistical correlation values are summarised in Table 1 below.

CHART 1: Australian PMI® vs ABS Manufacturing output (gross value added)



Sources: Ai Group, ABS *National Accounts*.

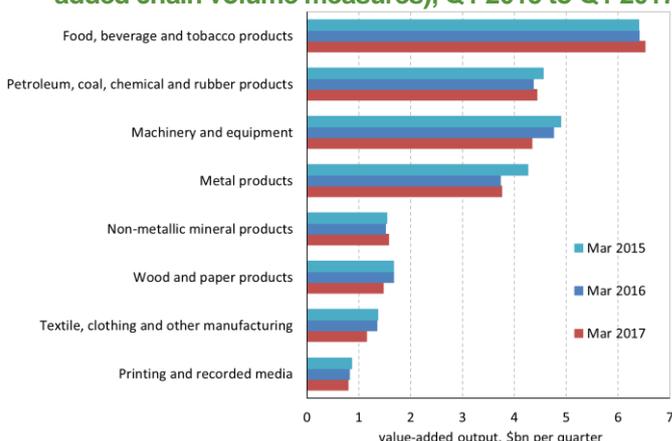
Changes in the **Australian PMI®** (six month moving average) is generally aligned with changes in the annual growth rate of ABS manufacturing real output (gross value added chain volume measure).

A simple linear regression model using data commencing from 2001 suggests that an **Australian PMI®** index reading (6mma) of 50.0 points is equivalent to around a 0% p.a. increase in manufacturing real output for the next quarter. This model also suggests that an average 1.0 point increase in the **Australian PMI®** index (6mma) over the previous six months is equivalent to around a 0.5 percentage point increase in the annual growth rate of manufacturing real output for the previous quarter.

Both the **Australian PMI®** and the ABS value-added output data show that manufacturing output declined sharply in 2008-09, in response to the disruptions caused by the GFC. Output growth recovered in 2010 but then contracted steadily until late 2015, roughly corresponding to the extended period in which the Australian dollar was over parity against the US dollar.

This data relationship appears to have changed after 2015, as structural shifts have begun to affect the composition of growth in manufacturing.

CHART 2: ABS manufacturing output volumes (gross value added chain volume measures), Q1 2015 to Q1 2017



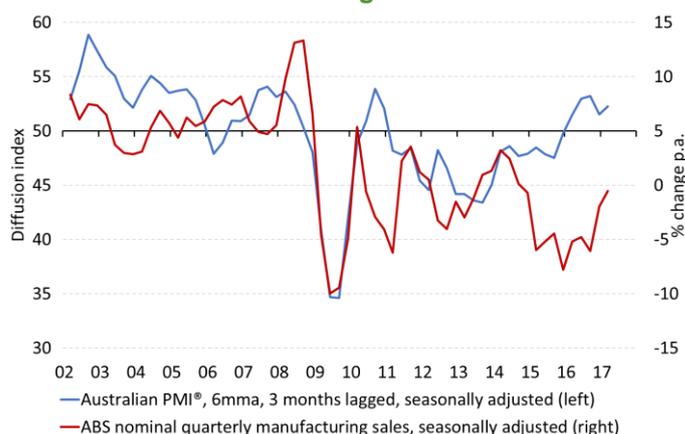
Source: ABS *National Accounts*.

In 2016 and 2017, the **Australian PMI®** has shown expansion while ABS value-added output declined. This divergence appears to be related to the progressive exit of automotive manufacturing, which (formerly) produced a high value of output from a (relatively) small number of businesses, including just three large auto assembly operators. The aggregate effect of this sector's exit is evident in the ABS output volumes data (cars had, until very recently, accounted for a large share of manufacturing output volumes) but is less clear in the **Australian PMI®**, because the latter measures changes in the proportion of businesses in each sub-sector that are increasing or decreasing their activity (across a range of indicators), rather than changes in the aggregate value of their output volume only.

Conversely, the **Australian PMI®** seems to have reflected the stabilisation and recovery in non-automotive manufacturing sub-sectors in 2016 and 2017 more strongly than has the ABS value-added output data. Activity in food and beverages processing, non-metallic minerals production (mainly building materials) and metal products accelerated through 2016 and 2017. This growth countered some of the effects of declining automotive production in the **Australian PMI®**.

ABS value-added data at the sub-sector level confirm that output volumes increased in the year to Q1 2017 in food and beverages production (+1.7% p.a.), non-metallic minerals production (3.6% p.a.), petroleum and chemicals production (1.7% p.a.) and metal products (0.5% p.a.). Food and beverages manufacturing accounts for 27.1% of all manufactured output volumes in 2017, up from 23% in 2007 and 23% in 1997.

CHART 3: Australian PMI® vs ABS Manufacturing Nominal Sales



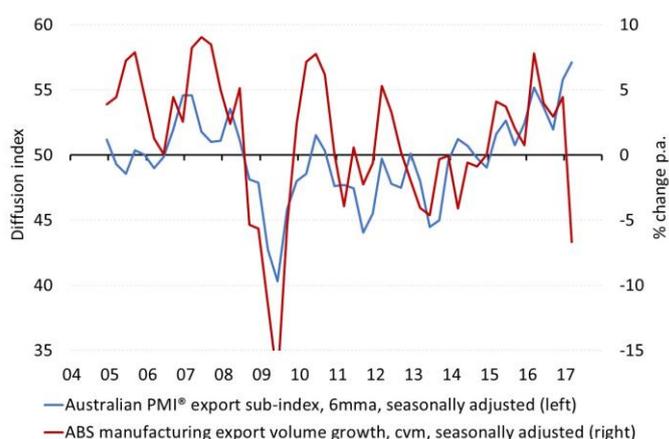
Sources: Ai Group, ABS *Business Indicators*.

Changes in the **Australian PMI®** (six month moving average) appear to lead annual growth in ABS manufacturing nominal sales by around three months. A simple linear regression model using data commencing from 2001 suggests that an **Australian PMI®** reading (6mma) of 50.0 points is indicative of around a 2% p.a. increase in manufacturing nominal sales for the following quarter. This model also suggests that a 1.0 point increase in the **Australian PMI®** (3mma) at the end of each quarter is equivalent to around a 0.7 percentage point increase in the annual growth rate of manufacturing nominal sales one quarter later.

The close relationship between the **Australian PMI®**s and nominal sales reflects the tendency among respondents to think about their output in nominal terms rather than in inflation-adjusted volume terms. This ‘nominal’ approach reflects standard business and accounting practices.

As with the relationship between the **Australian PMI®** and ABS value-added output (discussed above), these two series diverged from 2015. This appears to be related to the (formerly) high value of automotive manufacturing’s output and sales and its progressive exit since 2015.

CHART 4: Australian PMI® Export Sub-index vs ABS Manufacturing Export Volumes



Sources: Ai Group, ABS *Balance of Payments and International Investment Position*.

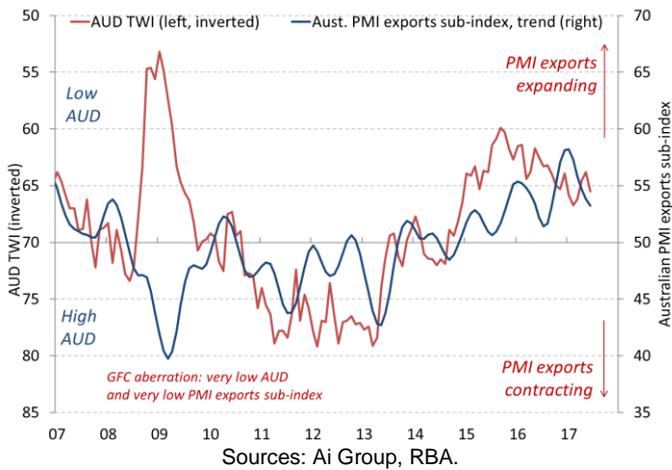
The **Australian PMI®** exports sub-index commenced in July 2004 as a monthly data series. Variations in the **Australian PMI®** exports sub-index (six month moving average) is well aligned with annual growth rates in the ABS data series for manufacturing export volumes.

A simple linear regression model using data from 2004 suggests that an **Australian PMI®** Exports sub-index reading (6mma) of 50.0 points is equivalent to around 1.4% p.a. growth in manufacturing export volumes. This model also suggests that a 1.0 point increase in the **Australian PMI®** Exports sub-index (6mma) at the end of each quarter is equivalent to around 0.9 percentage points increase in the annual growth rate of manufacturing export volume for the corresponding quarter.

Manufacturing export volumes dropped sharply in 2008-09 in response to the significant disruption to global trade caused by the GFC. Manufacturing export volumes subsequently recovered in 2010 but then entered a lengthy period of intermittent decline due to the high Australian dollar between 2011 and 2014. Both series then show a pickup in manufacturing export volumes in early 2015, coinciding with the decline Australian dollar after the mining investment boom.

Australian exports were severely disrupted by weather (Cyclone Debbie) in the March 2017 quarter. this disruption was evident in the ABS export volumes data but not in the **Australian PMI®** exports sub-index, which measures the proportion of businesses that are increasing or decreasing their exports rather than changes in the aggregate value of their exports.

CHART 5: Australian PMI® Export Sub-index vs RBA Australian dollar trade weighted index (AUD TWI), Jan 2007 to July 2017



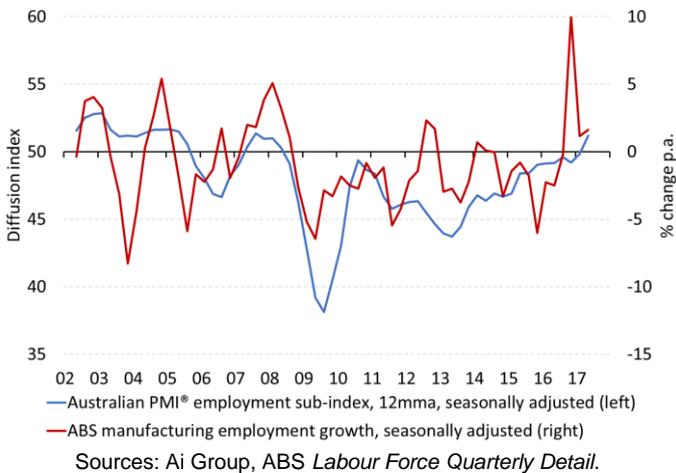
Changes in the **Australian PMI®** Exports sub-index are broadly aligned with changes in the Australian dollar, with little if any time lag evident. The relationship is strongest for the Australian dollar trade-weighted index (AUD TWI) rather than the AUD-USD exchange rate. This suggests the TWI provides a better representation of the range of currencies to which Australian manufacturing exporters are exposed, than does the USD exchange rate alone.

There is no single 'magic dollar' value that is preferred by all manufacturers, since the dollar is a two-edged sword for most businesses; a low dollar means better price competitiveness against imports and in global markets but higher imported input costs, while a higher dollar means reduced price competitiveness against imports and in global markets but lower imported input costs.

The ABS estimates that 10-12% of Australian manufacturing businesses export at least some of their output directly. Many others export through wholesalers. On the imports side, almost all manufacturers use some imported inputs, to varying degrees of intensity.

Over the decade from 2007 to 2017, the relationship between the AUD TWI and the **Australian PMI®** Exports sub-index suggests a TWI value of 70 points or less is conducive to growth in manufactured goods exports. Higher AUD TWI values tend to be correlated with flat or falling exports.

CHART 6: Australian PMI® Employment Sub-index vs ABS Manufacturing Employment

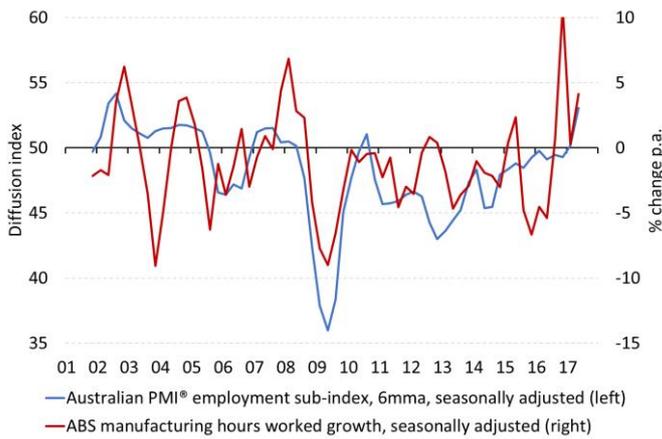


Changes in the **Australian PMI®** Employment sub-index (twelve month moving average) is broadly aligned with ABS manufacturing employment, over each 12 month period. The two series move together, although short periods of deviation exist, which may in part be explained by some volatility in the ABS labour market data, which is survey-based.

A simple linear regression model using **Australian PMI®** data commencing from 2001 suggests that an **Australian PMI®** employment sub-index (12mma) of 51.0 points or more is indicative of 0.4% p.a. growth or better in manufacturing employment numbers for the previous quarter. This model also suggests that a 1.0 point increase in the **Australian PMI®** Employment sub-index (12mma) is equivalent to around a 0.4 percentage point increase in the annual growth rate of manufacturing employment numbers in the previous quarter.

There appears to be a small but variable time lag between the **Australian PMI®** employment sub-index and the ABS employment series (hence the use of a twelve month moving average for the **Australian PMI®** employment sub-index in this analysis). This may be due to differences in the timing and source of information between the two, since the **Australian PMI®** is a survey of businesses, while the ABS labour force series is a survey of households.

CHART 7: Australian PMI® Employment Sub-index vs ABS Manufacturing Hours Worked



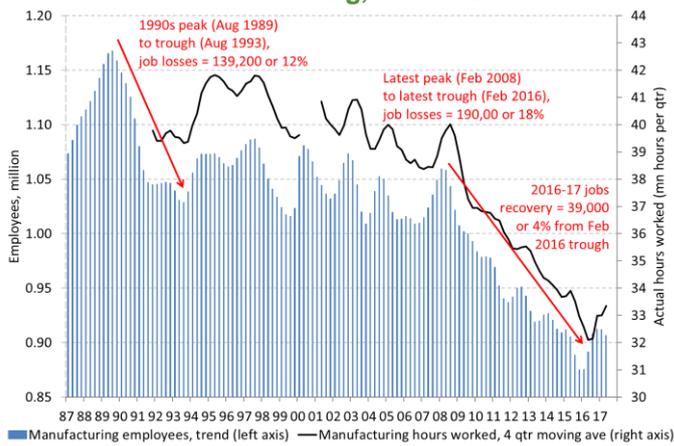
Sources: Ai Group, ABS *Labour Force Quarterly Detail*.

Changes in the **Australian PMI®** Employment sub-index (six month moving average) are also related to the annual growth rate in the ABS data series for 'manufacturing hours worked'. They appear to lead it by several months.

A simple linear regression model using data commencing from 2001 suggests that an **Australian PMI®** Employment sub-index result (6mma) of 51.0 points or more is indicative of 0.3% p.a. growth or better in aggregate hours worked in manufacturing for the quarter. This model also suggests that a 1.0 point increase in the **Australian PMI®** Employment sub-index (6mma) at the end of each quarter is equivalent to around a 0.4 percentage point increase in the annual growth rate of hours worked in manufacturing for the quarter.

The majority of manufacturing workers are full-time (defined by the ABS as 35 hours or more per week), but the percentage of part-time workers in manufacturing has grown over the past 30 years, from around 7% in 1987 to around 15% in 2017. This reflects changes across the whole workforce, one third of whom work part-time in 2017 (up from one fifth in 1987). In this context, changes in the number of hours worked can provide a more timely indication of labour demand than changes in the number of employees.

CHART 8: ABS employment and hours worked in manufacturing, 1987 to 2017



Sources: Ai Group, ABS *Labour Force Quarterly Detail*.

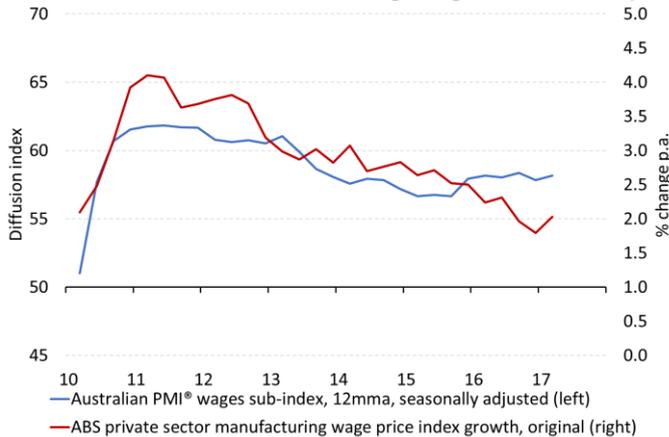
The unusual spike in growth in manufacturing employment and hours worked in the ABS employment data in 2016-17 is primarily due to a recovery in employment in food processing, which occurred relatively quickly after a long period of declining employment across the whole of manufacturing.

Food processing has been the strongest sub-sector for employment growth in both the ABS employment data and the **Australian PMI®** throughout 2016 and 2017. A smaller number of jobs returned to metals manufacturing and 'furniture and other manufacturing' over the same period. This recovery has helped to mitigate the job losses that are still occurring in 2017 in automotive manufacturing.

The size of this employment recovery during 2016-17 is small however, relative to the employment losses that preceded it. Around 40,000 jobs have returned to manufacturing since Feb 2016 (4% growth), compared with 190,000 jobs lost between 2008 and 2016 (18% decline).

A similar pattern of loss and recovery can be seen in total hours worked across manufacturing.

CHART 9: Australian PMI® Wages Sub-index vs ABS Private Sector Manufacturing Wage Price Index (WPI)



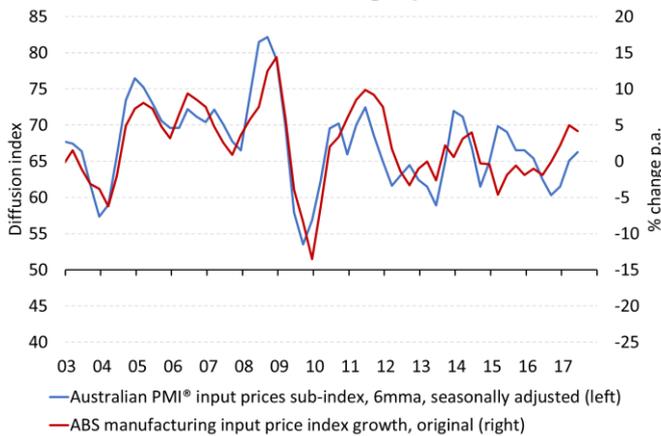
Sources: Ai Group, ABS *Wage Price Index*.

The seasonally adjusted **Australian PMI®** wages sub-index commenced on a monthly basis in May 2009 (previously collected quarterly). Over this period, changes in the Wage sub-index (12 month moving average) have been generally aligned with annual growth rates in the ABS Wage Price Index (WPI) data series for private sector manufacturing, with no time lag.

A simple linear regression model using **Australian PMI®** wages data commencing from May 2009 suggests that an **Australian PMI®** Wage sub-index reading (12mma) of 50.0 points is equivalent to around 1.0% p.a. growth in the ABS manufacturing WPI for that quarter. This model also suggests that a 1.0 point increase in the **Australian PMI®** Wage sub-index (12mma) at the end of each quarter is equivalent to around a 0.2 percentage point increase in the annual growth rate of the manufacturing WPI for the corresponding quarter.

Manufacturing wage growth recovered following the GFC disruptions of 2007-08, but has generally slowed since then. This pattern is evident in both the Australian **PMI®** wages sub-index and in the ABS WPI. It reflects ongoing spare capacity in the labour market together with weakening background inflation (as measured by headline and core CPI).

CHART 10: Australian PMI® Input Price Sub-index vs ABS Manufacturing Input Price



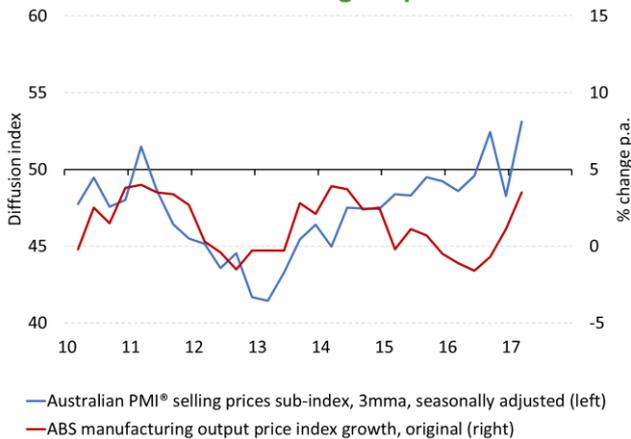
Sources: Ai Group, ABS *Producer Price Index*.

The seasonally adjusted **Australian PMI®** Input Price sub-index is available from June 2002 as a monthly data series. Changes in the **Australian PMI®** Input Price sub-index (6 month moving average) are closely linked to annual growth rates manufacturing input prices, as measured by the ABS in the *Producer Price Index* data series. The relationship between these two series appears to be quite close, with the series generally tracking in the same direction.

A simple linear regression model based on the **Australian PMI®** Input Price sub-index data from June 2002 suggests that a reading (6mma) of 65.0 points is equivalent to around 0.5% p.a. growth in manufacturing input prices, as measured by the ABS. This model also suggests that a 1.0 point increase in the **Australian PMI®** Input Price sub-index (16mma) at the end of each quarter is equivalent to around a 0.7 percentage point increase in the annual growth rate for the ABS manufacturing input prices for the corresponding quarter.

Manufacturing input prices fell significantly in 2008-09, due to the severe contraction caused by the GFC. They declined again over 2012-13 due to subdued manufacturing output and the appreciation of the Australian dollar. However, growth in manufacturing input prices picked up from mid-2013, and again more recently in early 2017, likely as a result of the depreciation of the Australian dollar between in these periods, as well as spiralling energy costs more recently.

CHART 11: Australian PMI® Selling Prices Sub-index vs ABS Manufacturing Output Price



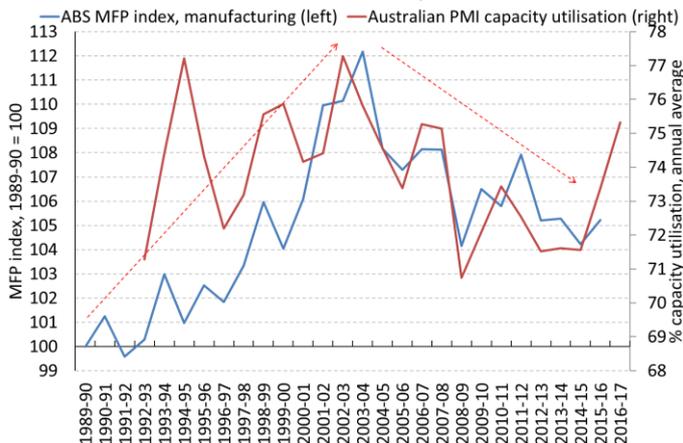
Sources: Ai Group, ABS *Producer Price Index*.

The seasonally adjusted **Australian PMI®** Selling Prices sub-index is available from May 2009. Changes in the **Australian PMI®** Selling Prices sub-index (three month moving average) broadly aligned with annual growth in the ABS data series for manufacturing output prices (published in the quarterly *Producer Price Index*).

A simple linear regression model using **Australian PMI®** data from May 2009 suggests that a Selling Price sub-index reading (3mma) of 50.0 points is equivalent to around 2.6% p.a. growth in manufacturing output prices, as measured by the ABS. The model also suggests that a 1.0 point increase in the **Australian PMI®** Selling Price sub-index (3mma) at the end of each quarter is equivalent to around a 0.3 percentage point increase in the annual growth rate of manufacturing output price for the corresponding quarter.

Manufacturing output prices declined markedly in 2008-09, in response to the significant contraction caused by the GFC, and again from 2012-13, due to the high level of the Australian dollar. Although the Australian dollar has since fallen, selling price growth has remained subdued for manufacturers, amid intense international competition and increasingly compressed margins.

CHART 12: Australian PMI® Capacity Utilisation Sub-index vs ABS Manufacturing Multifactor Productivity Index (1989-90 to 2015-16)



Sources: Ai Group, ABS *Estimates of Industry Multifactor Productivity, 2015-16*.

The **Australian PMI®** Capacity Utilisation sub-index commenced in September 1992 as a quarterly data series. It became a monthly series from September 2007.

Over the full economic cycle (commencing from the last Australian recession in 1989), changes in the **Australian PMI®** Capacity Utilisation sub-index (twelve month moving average) are reasonably aligned with movements in the ABS's estimated Multifactor Productivity Index (MFP) for manufacturing, which is available on an annual indexed basis only. The ABS multifactor productivity estimates are calculated from real GDP per combined unit of labour (quality adjusted hours worked) and capital.

Both the **Australian PMI®** Capacity Utilisation sub-index (annual average) and the ABS MFP estimate followed a very loose upward trend from 1989-90 to 2003-04, but both measures of productivity for the manufacturing industry have been decreasing since 2003-04. This is consistent with economic theory regarding the cyclical nature of productivity growth, which suggests stronger productivity improvements in the aftermath of recessions but slower rates of improvement thereafter.

In the case of Australian manufacturing, the cyclical decline in productivity from 2003-04 to 2014-15 was probably exacerbated by:

1. the disruptions of the GFC (from 2007-08) followed by
2. a persistently high trading range for the Australian dollar (from 2011 to 2015) followed by
3. the planned exit of automotive assembly (from 2015 to 2017).

2016-17 showed a strong lift in annual average capacity utilisation in the **Australian PMI®**. This possibly reflects the progressive, planned removal of automotive capacity from the market (and of automotive businesses from regular participation in the **Australian PMI®**). The completion of this exit process for an entire sector (which is an unusual development, by local and global standards) might mark a new turning point in both MFP performance and capacity utilisation for Australian manufacturing.

TABLE 1: AUSTRALIAN PMI® STATISTICAL CORRELATIONS^a

PMI Indexes ^b (x)	ABS (y)	Time Period ^c	Correlation	Simple linear Regression ^d	R ²
Australian PMI® (6mma)	Manufacturing Gross Value Added, chain volume measures, seasonally adjusted, % p.a. (Cat. 5206.0)	May 2001 to July 2017	0.68	$y = -25.63^{***} + 0.51^{***}x$	0.46
Australian PMI® (6mma, 3 months lagged)	Manufacturing Income from Sales of Goods and Services, current prices, seasonally adjusted, % p.a. (Cat. 5676.0)	May 2001 to July 2017	0.57	$y = -30.76^{***} + 0.65^{***}x$	0.32
Employment (12mma)	Manufacturing Total Employed Persons, seasonally adjusted, % p.a. (Cat. 6291.0)	May 2001 to July 2017	0.43	$y = -21.64^{***} + 0.43^{***}x$	0.19
Employment (6mma)	Manufacturing Total Actual Hours Worked, four quarter moving average, original, % p.a., (Cat. 6291.0)	May 2001 to July 2017	0.49	$y = -25.57^{***} + 0.51^{***}x$	0.24
Exports (6mma)	Manufacturing Export Volumes ^e , chain volume measures, seasonally adjusted, % p.a. (Cat. 5302.0)	July 2004 to July 2017	0.59	$y = -45.60^{***} + 0.94^{***}x$	0.34
Average Wages (12mma)	Private Manufacturing Wage Price Index (WPI), original, % p.a. (Cat. 6345.0)	May 2009 to July 2017	0.72	$y = -9.77^{***} + 0.22^{***}x$	0.52
Input Prices (6mma)	Manufacturing Input Prices, original, % p.a. (Cat. 6427.0)	June 2002 to July 2017	0.79	$y = -45.51^{***} + 0.71^{***}x$	0.62
Average Selling Prices (3mma)	Manufacturing Output Prices, original, % p.a. (Cat. 6427.0)	May 2009 to July 2017	0.29	$y = -22.98 + 0.51x$	0.08
Capacity Utilisation (average for each financial year, unadjusted)	Estimates of Manufacturing Multifactor Productivity (Cat. 5260.0)	1992-93 to 2015-16	N/A	N/A	N/A

Sources: Ai Group; various ABS publications.

^a Alternative moving averages and lags were also tested during this study. The table only includes those results that are most relevant and representative.

^b Seasonally adjusted unless indicated otherwise.

^c For monthly readings of the **Australian PMI®** sub-indexes and sub-sector indexes, the relevant quarter-end data are used to compare to the relevant ABS series for the corresponding quarter. For example, for the 2014 March quarter, the 12-month-moving-average for the **Australian PMI®** Wages sub-index for March 2014 is compared to the annual growth rate of the ABS Private Manufacturing Wage Price Index (WPI) for the March quarter.

^d *** indicates P-value is less than 1%; ** indicates P-value is less than 5%; * indicates P-value is less than 10%.

^e Calculated as sum of goods credits for machinery, transport equipment, sugar, beverages & other goods and other manufactures.

AUSTRALIAN INDUSTRY GROUP AUSTRALIAN PMI® QUICK HISTORY

1992 Commenced as a quarterly data series.

2001 Commenced as a monthly data series.

2001 Sub-sector index series and new sub-indexes added. Sub-sector indexes based on ANZSIC 1993 classifications.

2012 Sub-sector indexes updated to match ANZSIC 2006 classifications and re-weighted to reflect changing manufacturing structures, with all revised data backdated to May 2009.

Typical sample size: between 150 and 200 companies each month, with an average business size of around 100 employees per business. The **Australian PMI®** uses an internationally standardised 'diffusion index' methodology.

This note adds to earlier Ai Group research which studied the relationship between the **Australian PMI®** and the growth rates for various Australian GDP and manufacturing output measures, published in 2014 and 2010.

	Date commenced, quarterly	Date commenced, monthly
Australian PMI®	Sep 1992	May 2001
Activity sub-indexes		
Production	Sep 1992	May 2001
New Orders	Sep 1992	May 2001
Employment	Sep 1992	May 2001
Inventories (stocks)	Sep 1992	May 2001
Supplier Deliveries	Sep 1998	May 2001
Exports	-	July 2004
Sales	-	May 2009
Capacity Utilisation	Sep 1992	May 2009
Price sub-indexes		
Input Prices	-	Jun 2002
Selling Prices	Mar 1995	May 2009
Average Wages	Mar 1995	May 2009
Sub-sector indexes		
	Date commenced, monthly (a)	Date commenced, monthly (b)
Food, beverage & tobacco	May 2001	May 2009
Textiles, clothing, furniture & other	Jan 2003	May 2009
Wood & paper products	May 2001	May 2009
Printing & recorded media	May 2001	May 2009
Petroleum, coal, chemicals & rubber	May 2001	May 2009
Non-metallic minerals	May 2001	May 2009
Metal products	May 2001	May 2009
Machinery & equipment	May 2001	May 2009
State sub-indexes (c)		
	Date commenced, monthly (a)	Date commenced, monthly (b)
NSW	May 2001	May 2009
Vic	May 2001	May 2009
Qld	May 2001	May 2009
South Australia	May 2001	May 2009
Western Australia	May 2001	May 2009
Tasmania	May 2001	May 2009

(a) ANZSIC 1993 classifications and industry weights.

(b) ANZSIC 2006 classifications and annual average (2010-11) industry weights.

(c) State sub-indexes are not published with the **Australian PMI®** each month. They are available on an annual subscription basis only.

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What is the Australian PMI®? The Australian Industry Group **Australian Performance of Manufacturing Index (Australian PMI®)** is a seasonally adjusted national composite index based on the diffusion indices for production, new orders, deliveries, inventories and employment with varying weights. An **Australian PMI®** reading above 50 points indicates that manufacturing is generally expanding; below 50, that it is declining. The distance from 50 indicates the strength of the expansion or decline. Survey results are based on a rotating sample of around 200 manufacturing companies each month. Seasonal adjustment and trend calculations follow standard statistical methodology. The current industry classifications commence from May 2009, based on the ANZSIC 2006 coding system and ABS 2011-12 industry weights.

For further economic analysis and information from the Australian Industry Group, visit <http://www.aigroup.com.au/economics>.

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