Labour productivity and employment in Australian manufacturing SMEs

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Abstract This paper examines the relationship between labour productivity and employment in Australian manufacturing small and medium enterprises (SMEs). The results indicate that labour productivity of SMEs varies substantially between industries within the manufacturing sector, but on average labour productivity for manufacturing SMEs increased at a faster rate than that of large manufacturing enterprises across all industries. All manufacturing industries except one recorded employment growth during the period under study. However like labour productivity growth, employment growth also varies across industries within the manufacturing sector. Yet the study could not establish any definite relationship between labour productivity growth and employment. This finding is consistent with some previous studies.

Unemployment represents a significant cost to society in both economic and social terms. Employment generation is an essential part of the government's economic policy objectives. There has been a significant amount of research undertaken over the last three decades on the employment generation potential of small and medium enterprises (SMEs). The increased interest in the economic role of small business in Australia and other OECD countries since the early 1970s reflected a recognition that small businesses constitute a very large proportion of business enterprises and that they significantly contribute to economic growth and employment.

The economic fluctuations of the early 1980s and 1990s speeded up the process of reducing the number of large enterprises, a process that had been exacerbated by the mergers and takeovers in the 1980s. Large firms faced with readjustment in order

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to stay competitive in the changing economic environment have started to decentralise or subcontract specific tasks to smaller, more specialised firms.

Over the last three decades the OECD economies including Australia have been characterised by declining shares of manufacturing in terms of both GDP and employment. Manufacturing has traditionally been the principal employer of both skilled and unskilled labour. This has changed over the last two decades. Managerial diseconomies and advancements in technology have promoted a smaller, highly skilled labour force, effectively turning many firms into smaller ones. This shift to smaller firms is very pronounced in those areas where specialised products produced primarily on a small scale are in demand.

Small firms are considered as the breeding ground for the entrepreneurship that is essential to economic growth and prosperity and, hence to growth in employment. Many of these entrepreneurs can identify small gaps in the market left by other firms and take considerable risks in moving to fill those gaps. As the demand for specialised goods and services increases, so does the demand for workers in small firms that can satisfy the demand. Easier credit availability and new technology in the 1990s helped some small firms to enter into new markets that they could not enter before.

Policy makers have become increasingly interested in the role of small business in general and its employment generation potential in particular. This has made small businesses a central focus of many governments' labour market policies in the OECD countries.

Birch (1979) claimed that in the United States small firms were responsible for creating a disproportionate share of new jobs. Following Birch's work, many studies on the same topic have been undertaken involving OECD countries (see Storey & Johnson, 1987). Their results tentatively suggest that policies designed to increase the number of small businesses in an economy are likely to impact upon employment creation/unemployment reduction. However, most of these studies suffer from methodological problems (see Loveman & Sengenberger, 1990). Birch (1987), in another updated and more comprehensive study, confirmed his earlier conclusion. The Bolton Report (1971) suggested that in many respects the small firms provides a better environment for the employees than is possible in most large firms. In the U.K., the large increase in the number of very small firms was attributed mainly to the increase in the proportion of the labour force that was self-employed, almost 70 percent have no employees. The number of self-employed rose from 1.906 million in June 1979 to 3.380 million in June 1990, an increase of 77 percent (Stanworth & Gray, 1991). Williams (1989) found that, over the period from 1970 to 1987, small firms contributed 70 percent of net employment growth in Australia. However, it must be noted that many others have come to different conclusions in relation to small businesses' contribution to employment. Despite conflicting evidence, there is a general agreement that small firms do contribute to employment growth at least in line with their share of total employment (see Loveman & Sengenberger, 1990).

Rapid globalisation has caused greater specialisation in manufacturing output in Australia, resulting in changes in the pattern of employment in both large and small enterprises. The employment consequences of productivity growth are a source of

much community concern and uncertainty. The concern stems from the perception that productivity improvement reduces job security and employment opportunities and increases inequalities in earnings between low-skilled and high-skilled jobs (IC, 1997). There is evidence that income inequality has been on the rise in Australia, as it is in many other industrialised countries. This income inequality is reflected in the declining share of unskilled labour in total employment.

Two opposing forces are at work in determining the relationship between labour productivity and employment. Employment must fall as productivity rises because the same level of output can be produced with a lower level of labour input. However, higher productivity causes prices to fall which will lead to increased demand for the product and hence higher demand for labour. Galí (1999) argues that productivity growth in the short run may reduce employment but in the long run will have a positive impact on the demand for labour. This paper attempts to study the relationship between labour productivity and employment in Australian manufacturing SMEs between 1994–1995 and 1999–2000. Given that SMEs play a significant role in employment generation in the sector, the study will help us to understand the nexus between productivity and employment.

The objective of the paper is to provide the estimates of labour productivity using the Cobb-Douglas production function at the Australia New Zealand Standard Industry Classification (ANZSIC) two-digit level using Australian Bureau of Statistics (ABS) data. The paper will examine the relationship between labour productivity and employment in manufacturing SMEs by highlighting the factors that are likely to have contributed to productivity growth and employment during the period from 1994–1995 to 1999–2000. The paper also provides a brief discussion on the quality of the data and the method used in measuring productivity.

SMEs in the manufacturing sector

Manufacturing SMEs in this paper are defined as management units employing fewer than 100 persons. This statistical definition has become quite acceptable in Australia in the absence of a clear demarcation between small and medium firms (see BIE, 1995).

The manufacturing sector in Australia has undergone significant changes since the mid 1980s as a result of substantial tariff reductions. Other economic reform measures such as deregulation of financial and foreign exchange markets have also contributed to opening up the economy to international market forces. The competitive pressure generated as a result of an increasingly open economic environment has caused structural changes in the way business is conducted nowadays. An increasing number of firms are seeking business opportunities overseas.

Manufacturing's share of GDP in Australia as in other industrialised countries has declined over the last three decades. It stood at 11.9 per cent in 2000–01. While the manufacturing sector's share of total output has been declining, its share of exports has almost doubled over the last two decades. SMEs employed 45.9 per cent of the manufacturing labour force, contributed 27.3 per cent to manufacturing sales and

service income and created 33.9 per cent of manufacturing value added in 2000–01 (Table 1).

Between 1993–1994 and 2000–2001, SMEs increased their share of employment, sales and services and value added. SME management units accounted for 97.7 per cent of the total of management units in 1999–2000 in the manufacturing sector (see ABS, 2001). SMEs increased their share of establishments by 2.1 percentage points between 1990–1991 and 1999–2000 in the sector.

The economies of OECD member countries appear to be undergoing two basic changes: a reduction in the average size of the business firm and an increase in the turbulence or volatility among jobs and firms (OECD, 1996). The relative decline in the share of large firms and employment in those firms in the manufacturing sector is largely due to restructuring necessitated by the increasing openness of the economy and the growing pressure exerted by globalisation. Economic policy reforms focusing on Australia's international competitiveness have had significant impact on improved productivity. This has caused large enterprises, especially in the manufacturing sector, to externalise most non-core activities to other firms most of which are SMEs. Technological change has allowed SMEs to achieve economies of scale through networking and pooling of resources.

Measuring labour productivity

Before we discuss how to measure labour productivity, we need have a clear understanding of the concept of productivity itself. Productivity is a measure of the efficiency with which inputs are used to produce output. Therefore it is important to provide a precise definition of the concept of productivity (see Diewert, 1992). Productivity is a measure of the rate at which inputs are transformed into output. Productivity therefore provides the technical relationships that exist in production between inputs and outputs. It is a measure of technical efficiency not economic efficiency. The latter concerns the optimal allocation of quantities of inputs (or factors) in the process of production.

Table 1 SME activity in the manufacturing sector, Australia, 2000–2001 (percent)

ANZSIC	Industry	Employment	Sales & services income	Value added
21	Food, beverage & tobacco	25.8	16.3	15.3
22	TCF & leather	63.3	50.8	54.9
23	Wood & paper products	54.2	29.3	32.7
24	Printing, publishing & recorded media	48.2	35.6	33.6
25	Petroleum, coal, chemical & associated products	38.1	18.0	28.5
26	Non-metallic mineral products	39.5	25.3	21.9
27	Metal products	54.1	38.4	49.7
28	Machinery & equipment	44.4	25.0	33.2
29	Other manufacturing	86.5	80.5	81.6
21–29	Total manufacturing	45.9	27.3	33.9

Source: Australian Bureau of Statistics (2002), Catalogue No. 8221.0

The level of output within a firm or an industry depends on quantities of labour, capital and the state of technology. Productivity growth over time will also reflect the growth in these factors over time. Productivity growth is also directly linked to economic growth. The most common measure of productivity usually used is labour productivity or output per person employed or per hour worked. Conceptually hours worked is better measure because this takes into account both changes in persons employed and overtime worked, standard weekly hours, leave taken and the proportion of part-time workers. However, hours worked can be difficult to measure and are different from paid-for hours. Workers are often paid for standard weekly hours without being fully utilised (see Ball & St Cyr, 1966). In recent times there are ample evidence to suggest that working unpaid overtime is quite widespread in Australia. (see Wooden, 2001). In either case hours worked will not reflect the actual hours worked.

Labour productivity performance is also influenced by other factors such as capital equipment, new technology such as information and communication technology, improved management skills etc. Changing patterns of factor use and changes in the quality of the workforce also influence labour productivity. Both of these changes could have significant effects on output. However, to estimate multifactor productivity (MFP) is beset with computational difficulties arising from conceptual as well as practical problems such as the issues relating to the aggregation of different kinds of capital. This also gets further complicated if the industry aggregation level is high. Hence productivity is defined as output per unit of two or more factor inputs, the computational problems multiply as a number of measurement and definitional issues compound (Barrell, Mason, & O'Mahony, 2000).

In contrast labour productivity is easy to understand and easy to estimate. It is a reasonable indicator of technical efficiency because it shows the relationship between outputs and labour inputs given the technology within the firm or the industry, and it will reflect the changing pattern of factor use. Other things being equal, labour productivity will increase with capital intensity (i.e., the ratio of capital to labour). However as Lowe (1995) suggests labour productivity is clearly pro-cyclical, falling in recessions and increasing in booms. Despite this caveat, the period covered in this study is short and, consequently, not affected by significant fluctuations in output.

Labour productivity is generally analysed in the context of multifactor productivity. Therefore labour productivity can be regarded as a measure of overall productivity performance. In this way also any limitations relating to the measurement of productivity can be easily identified and understood. Furthermore changes in output per employed person can be seen as the outcome of production, employment and capital investment decisions. As such the measure provides one means of summarizing the outcome of a range of different decisions (Gretton & Fisher, 1997).

Productivity is measured in terms of output. Output is most commonly measured in terms of value, but in some cases physical units are also used. Production in terms of value can be measured either as the real value of turnover or the real value added. However, turnover does not provide a precise measure of productivity as it incorporates double counting of bought in inputs. Therefore production is measured as the real value added by the industry. Value added is defined as sales less the cost

of raw materials, services and components used up to produce them. Data on value added is deflated by an index of domestic transaction prices to obtain the real value added. When output is defined as value added, the factor inputs are labour and capital (see Muellbauer, 1991).

Labour productivity, in theory, can be estimated by the marginal product of labour which is $MP_L = \Delta Q / \Delta L$ given the technology. Given the difficulty associated with estimating the marginal product of labour, the average product of labour which is $AP_L = Q/L$ is usually used to estimate labour productivity. This is relatively simple to calculate, hence it is the preferred method to calculate labour productivity.

Underlying the estimation of output-input relations stands the concept of the production function, i.e. the notion that the physical volume of output depends on the quantities of productive services, or inputs, employed in the production process and the efficiency with which they are utilised (Kendrick, 1961). Production function modelling is an important tool in analysing returns to scale, technical change and productivity growth. The estimation of labour or multifactor productivity is usually analysed using the neoclassical production function, often a Cobb-Douglas production function for empirical estimations (see Greenhalgh & Gregory, 2000). Therefore a basic functional form can be formulated through the use of a Cobb-Douglas production function with constant returns to scale to estimate labour productivity.

$$Q = AK^{\alpha}L^{\beta} \tag{1}$$

Q is output measured in terms of value added, K is capital assets, L is labour employed, A is technology and α and β are the elasticities of output with respect capital and labour, where $\alpha + \beta = 1$. The functional form specified above assumes constant elasticity of substitution between capital and labour. By rearranging equation (1), the relationship can thus be transformed into:

$$Q/L = AK^{\alpha}L^{\beta-1} = A(K/L)^{\alpha} \quad since \ \alpha + \beta = 1 \tag{2}$$

Equation (2) now clearly suggests that labour productivity is dependent on the capital to labour ratio given the level of technology. Hence changes in output, will result from changes in this ratio. However, as α is expected to be positive, higher values of the capital to labour ratio will generate higher values of output per employee. Since the parameters are not estimated in the model, the appropriate deflator must be used to estimate labour productivity.

Labour productivity and employment

The impact of productivity growth can be analysed both at the macro level and the micro level of the economy. At the macro level productivity growth is a major source of output growth, leading to increased demand for labour. Thus at the macro level there is a positive relationship between productivity growth and employment.

But at the firm level, productivity growth can have either a negative or a positive effect. Higher productivity implies that the same level of output can be produced with less labour input thus reducing the demand for labour. On the other hand,

output growth resulting from productivity growth will cause unit costs to fall, increasing the firm's profitability. This will make the firm more competitive in the market, and the firm is likely to expand output by hiring more labour. How these two forces will impact on employment depends on a number of variables such as the market structure, technology (i.e., labour augmenting or not), price elasticity and macroeconomic variables such as inflation, economic growth, wages and the trade balance. Most importantly how wages and prices respond to productivity growth will significantly affect the decision to hire or fire at the firm level.

Data and industry classification

The empirical analysis in this paper is based on published data from the Australian Bureau of Statistics (ABS). Data have been collected from various issues of *Small Business in Australia* (Cat. No. 1321.0) *and Australian System of National Accounts* (Cat. No. 5204.0). Data in the first named publication have been obtained from a number of different sources. However, much of the data presented in the publication have been obtained from sample surveys and are therefore subject to both sampling and non-sampling errors. ABS data exclude non-employing businesses.

All monetary values have been deflated using the GNE deflator for the purposes of comparison. The data available on labour inputs are based on employment numbers; therefore they remain the main measure of labour inputs used to estimate labour productivity.

The manufacturing sector is highly diverse involving at the one spectrum very low levels of processing (simply transformed manufactures (STMs)) such as the production of some agricultural and mineral products. At the other end of the spectrum it involves the application of highly sophisticated and complex production process (elaborately transformed manufactures (ETMs)). Given the diversity of the sector and greatly varying types of activities within the sector, this study divides the manufacturing sector into nine industries at the two-digit Australia New Zealand Standard Industry Classification (ANZSIC) level.

Results

Table 2 presents estimates of labour productivity levels for small and medium enterprises (SMEs) in the manufacturing sector for the period between 1994–1995 and 1999–2000 at the two digit ANZSIC disaggregated levels. The results were obtained by the estimation method outlined in equation 2.

SMEs increased their productivity levels between 1994–1995 and 1999–2000 across all industries. They achieved the highest productivity gains in the non-metallic mineral products followed by the petroleum, coal, chemical and associated products and metal products industries. The lowest productivity growths for SMEs were recorded in the printing, publishing and recorded media followed by the food, beverage and tobacco and machinery and equipment industries. SMEs in four industries achieved above average productivity gains. They are the TCF and Leather; wood and paper products; printing, publishing and recorded media and metal products industries.

Table 2 Changes in productivity levels

ANZSIC	Industry	Productivity levels		
		1994–1995	1999–2000	Percent change
21	Food, beverage and tobacco	0.012246	0.014776	20.66
22	TCF and leather	0.035820	0.049188	37.32
23	Wood and paper products	0.041215	0.056032	35.95
24	Printing, publishing and recorded media	0.043194	0.049361	14.28
25	Petroleum, coal, chemical and associated products	0.025084	0.0431125	71.92
26	Non-metallic mineral products	0.020719	0.042949	107.29
27	Metal products	0.055767	0.093692	68.01
28	Machinery and equipment	0.025873	0.033793	30.40
29	Other manufacturing	0.157687	0.232818	47.65
21–29	Total manufacturing	0.031435	0.044448	41.40

SMEs on average during this 5 year period nearly doubled their productivity in Australian manufacturing. The factors that have contributed to such productivity performance are likely to include increased competitive pressure arising from an open economic environment, the introduction of new technology in production, organisational restructuring, changes in management style to respond to the changing business environment caused by globalisation and other potentially productivity enhancing reforms over the late 1980s and 1990s (Barnes, Johnson, Kulys, & Hook, 1999). There is evidence to suggest that work intensity has increased since the mid 1980s (see Quiggin, 1998). Increased work intensity also is likely to have contributed to increased labour productivity. The labour market reforms and upgrading of skills necessitated by the introduction of new technology also have contributed to increased productivity.

The results also indicate that levels of productivity achieved by SMEs also vary substantially across industries in the manufacturing sector. SMEs recorded the highest productivity levels in the other manufacturing industry category which includes prefabricated metal building-sheds, furniture, bed, chairs, desks, jewellery, coins, gem-cutting, toys and sporting goods and musical instruments. Some of the output of this group are high value added goods(e.g., furniture, jewellery and musical instruments). In this group, SMEs accounted for 99.3 per cent of management units and 86.5 per cent of employment. SMEs achieved the lowest levels of productivity growth in the food, beverage and tobacco industry. This industry has always been dominated by large enterprises including large multinational enterprises. Lattimore (1990) found that there was enormous variation in the productivity performance of the various industries that comprise manufacturing. Rao, Shepherd, and Pilat (1995) also found from their study that labour productivity varied across industries. The reasons for productivity variations across industries are most likely to be differences in industry structure, capital intensity, labour skills and more importantly the uptake of new technology. It is also likely that differences in productivity performance across industries also reflects the extent of reforms and the length of time each of these industries have undergone the reform process.

Like labour productivity, employment growth also varied significantly between industries (see Table 3). All the industries in the manufacturing sector experienced employment growth except the TCF and leather industry in which employment

declined by 10 per cent. The TCF and leather industry is one of the two most protected industries in Australia. The nominal and effective rates of protection for textiles stood at 6 per cent and 17 per cent respectively and for clothing these rates were 19 per cent and 34 per cent respectively. The manufacturing sector as a whole enjoyed only 3 per cent nominal and 5 per cent effective rates of protection in 2000–01 (see Havrila & Gunawardana, 2001). Conlon (1998) observed that a disproportionately high level of assistance was afforded to TCF relative to their low levels of employment. Rao et al. (1995) indicated that labour productivity was greater in the protected, more simply transformed manufacturing branches, in which labour was being shed most rapidly. This lends further support to the proposition that industry protection does not protect jobs.

Despite such high levels of protection, the TCF industry, still faces significant competition from imports. This is likely to result in the use of labour substituting technology by local firms to stay competitive in the domestic market. An intensely competitive environment will encourage innovative activities resulting in the adoption of skill-intensive technology. This biased technological change can lead to a decrease in the demand for low-skilled labour and an increase in the demand for high skilled labour. However, the net result will generally be labour shedding. Moreover workers' time is now used more intensively because of new technology causing further decline in the demand for labour while productivity rising.

The highest level of employment growth was achieved by the petroleum, coal, chemical and associated products. This industry also achieved the second highest level of productivity growth. PC (1999) has suggested that while there have been employment reductions in certain industries, these reductions have not been universal. In fact, employment has grown along with the productivity surge in the 1990s. Parham (1999) for instance has indicated that strong growth in labour demand in parallel with increased productivity was associated with a decline in real wages.

The estimated correlation coefficient between productivity growth and employment growth is 0.56. However this is not statistically significant. Hence we can infer two things. One is that there is a positive relationship between productivity growth and employment growth, but the second is that the relationship is not significant. Therefore no sound relationship could be definitely established between these two

Table 3 Changes in productivity and employment levels, 1995–1996 to 1999–2000 (percent)

ANZSIC	Industry	Percent Δ Productivity level	Percent Δ Employment level
21	Food, beverage & tobacco	20.66	10.8
22	TCF & leather	37.32	−10.1
23	Wood & paper products	35.95	0.7
24	Printing, publishing & recorded media	14.28	7.8
25	Petroleum, coal, chemical and associated product	71.92	22.4
26	Non-metallic mineral products	107.29	18.8
27	Metal products	68.01	7.4
28	Machinery and equipment	30.4	2.6
29	Other manufacturing	47.65	7.6
21–29	Total manufacturing	41.40	6.2

variables during the period under observation. Lentz and Mortensen (2005) also found that there was no correlation between employment size and labour productivity. Bailey, Bartelsman, and Haltiwanger (1996) similarly found that both employment growth and employment losses occurred in manufacturing firms that experienced increasing productivity.

Conclusions

The results clearly indicate that significant labour productivity growth was achieved by SMEs in the manufacturing sector between 1994–1995 and 1999–2000. In fact the labour productivity level almost doubled. This productivity growth was independent of significant business cycle effects. Nonetheless substantial variations in labour productivity growth across industries within the sector were evident. During the same period, employment also increased in SMEs in all industries except in the TCF and leather industry while aggregate employment in the manufacturing sector declined. Like labour productivity growth, employment growth also exhibited wide variations across industries.

Although labour productivity growth paralleled with employment growth during the period under observation, the study could not establish any definite relationship between these two variables. This finding is consistent with the results of other studies. The increasing competition brought about by a more open economic environment and the adoption new technology is likely to have contributed to productivity gains. Productivity growth is likely to continue to flow from investments in new technology for some time to come. However certain inbuilt institutional rigidities such as those reflected in the operation of factor markets, may work against it.

While labour productivity is influenced by the initiatives taken at the firm level, appropriate governmental policy action will also encourage firms to adopt productivity enhancing activities. The proposed further changes to labour laws and labour market regulation will likely to create further flexibility in labour markets. These changes such as relaxation of unfair dismissal laws are especially directed to benefit SMEs and are expected to help them achieve higher productivity. Productivity growth will stimulate economic growth and result in increased employment opportunities. However, the main policy implications of the results this study are that public policy reforms directed at productivity growth can be pursued without compromising the objective of employment growth. The effectiveness of such policy reforms, however, are conditional upon sustained wage moderation, and continued labour market reform in line with the changing economic environment. Such reforms are likely to contribute both to labour productivity and employment growth.

This paper also has highlighted the importance of further research on the causes of and conditions required for productivity growth. Further research must cover a longer time period and focus at a more disaggregated level. The other issue that also needs critical examination is the importance of the skills-upgrading necessitated by technological change. How does this contribute to labour productivity, and what are its consequences for employment in general? How does it reflect the changing nature

of employment, in particular in the manufacturing sector and with special emphasis on manufacturing SMEs?

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