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MANUFACTURING INDUSTRY IN THE AUSTRALIAN ECONOMY:

Its Role and Significance

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Manufacturing industry has a number of inter-related characteristics which, taken individually or collectively, provide an important case for its continuing significance in the Australian economy.[1] Firstly, there is the crucial role in technical change through high levels of Research and Development and product and process innovation. This innovation is not only important in raising the productivity of manufacturing industry, but the diffusion of these products to all industries increases economy-wide efficiency and innovation. Secondly, manufacturing industry accounts for 50 per cent of long-run productivity growth in the Australian economy.

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1 Arguments for the key role of manufacturing industry in the growth of *per capita* output, based on a number of characteristics unique to or disproportionately represented in manufacturing, have frequently been made over the years in Australia. Some of these include Cameron (1960), Metal Trades Unions (1984), Australian Manufacturing Council (1989, 1990), Australian Business Foundation Limited (1997), Brain (1992; 1999), Bell (1997), Stewart (1994) and Genoff and Green (1998). Critiques of these arguments are to be found in Brown and Julius (1993) and Industry Commission (1996;1997). These critiques generally accept the empirical evidence adduced in favour of manufacturing, but argue that services are rapidly acquiring those characteristics which were previously unique to manufacturing, and/or that the welfare effects of selective assistance to manufacturing out-weigh the benefits.

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Thirdly, manufacturing has a key role in the maintenance of high wage employment. Over the last two decades an increasing share of employment has occurred in low productivity, low wage service industries such as Retail; and Accommodation and Cafes. This is contributing significantly to growing earnings inequality with adverse consequences for quality of life and social cohesion. Fourthly, manufacturing has a principal role in redressing persistent current account and terms of trade problems. Fifthly, there are strong interdependencies between manufacturing and services, in that the growth of high technology service industries and an advanced manufacturing base are mutually supportive. Finally, there are strong linkages between manufacturing and the domestic economy, such that manufacturing can be a powerful driver for the rest of the economy or, if it is faring badly, a source of general economic stagnation. For all these reasons, manufacturing has a distinctive economic status which needs to be acknowledged in the formulation of economic policies.

Table 1: Change in Share of Manufacturing in GDP, Selected High Income Countries. 1980-1997

Country	1980	1997
Australia	19	14
Austria	25	20
Belgium	21	18
Canada	19	15
Denmark	20	19
Finland	28	25
France	24	19
Germany	30	24
Italy	28	20
Japan	29	24
New Zealand	22	16
Norway	15	11
Singapore	29	24
U.K.	27	21
U.S.	22	18
Total High Income Average	**25**	**21**

Source: World Bank (1999) *World Development Indicators*: Table 4.2

Manufacturing in Advanced Economies

Almost all high *per capita* income nations (as defined by the World Bank 1999) continue to have a large manufacturing base, and the rapid acquisition of manufacturing industry remains the chosen path to high *per capita* income among developing countries, such as China and Korea in the Asia-Pacific (Singer 1984; Chenery, Robinson and Syrquin 1995; Wade 1990). Australia has allowed, and indeed encouraged, its manufacturing base to decline to the point that its share of GDP is one of the lowest among developed nations. In 1997 manufacturing represented only 14 per cent of Australian GDP, compared to around 21 per cent of output for all other high income nations. For technically advanced countries such as Japan and Germany it represents 24 per cent of output (Table 1).

Manufacturing's share of total output in Australia is 33 per cent smaller than the average within high income countries. Although the share of GDP represented by manufacturing has decreased over the years, manufacturing output has been increasing. For example, the real level of manufacturing output increased by 100 per cent between 1962-63 and 1994-95 (Industry Commission 1996:19). The decline in the share of domestic manufacturing output in GDP is due to a number of factors, such as increased inter-industry specialisation whereby activity previously undertaken within manufacturing is contracted-out to other industries (Industry Commission 1996:23). Rowthorn (1997) examined this inter-industry specialisation in terms of the share of GDP devoted to the production of 'goods' (manufacturing, mining, agriculture, construction, gas and electricity); 'goods related services' (transport, wholesale, retail, technical education, finance, insurance) and 'free-standing' services (Rowthorn 1997:72-74). He concluded that:

> Despite all the talk of a post-industrial era, the OECD economies are still mainly devoted to the production, distribution, and allocation of material goods. A growing proportion of the people involved in this process are employed in specialist service firms or government agencies, whilst the share of traditional goods-producing sectors is declining ... Far from being 'service economies', the OECD economies remain firmly anchored in the world of material goods' (Rowthorn 1997:75).

Another reason for the decline in manufacturing's share of total output is the so-called 'productivity-price paradox' whereby the relative price of the outputs of industries with higher productivity declines against industries with lower productivity (Industry Commission 1996: 23). Even if manufacturing increases its volume of output, its share of GDP (in current prices equivalent to price multiplied by quantity produced) may decline relative to other industries which have a lower rate of productivity growth. If the rate of manufacturing output growth is less than its rate of productivity growth then its share of GDP will tend to decline.

It is also argued that one reason for manufacturing's declining share of GDP is a lower income elasticity of demand for manufactures at high income levels (Kaldor 1966). Whilst it is undoubtedly true that the income elasticity of demand for manufactures declines at high income levels, the decline in domestic consumption of manufactures (as a share of GDP) is not as marked as the decline in domestic production of manufactures. In 1968-69 imports of manufactures were equivalent to 39.3% of total Australian manufacturing value-added. In 1996-97 imports were equivalent to 106.2 per cent of Australian manufacturing industry gross product.[2] The growth of domestic consumption of manufactures, therefore, is significantly higher than domestic production, and the gap has been widening over the long run.

This pattern of differential growth between domestic and imported manufactures is due to higher income elasticity of demand for imported manufactures (Brain 1992). In turn this is due to differences in the commodity composition of imports and domestic manufactures. A comparatively large share of the latter is derived from industries such as Food Beverages and Tobacco, and Basic Metal Manufactures, for which domestic and world demand is rising comparatively slowly and which experience intense competition from newly industrialising countries. (This is examined further below).

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2 1968-69 figure derived from Industry Commission 1995: Table B1. 1996-97 figure derived from *Manufacturing Industry Australia*. 8221.0 1996-97: Table 1 and Department of Foreign Affairs and Trade 1998: Table 1. The concepts of value-added and industry gross product are for most practical purposes identical.

The fact that Australia's manufacturing sector is significantly smaller than that of other high income countries and the share of imported manufactures, notably higher technology products, has grown rapidly over the last three decades, has important implications for long-run sustainable growth. The structure of the Australian economy is such that it does not gain the benefits that a large and dynamic manufacturing base could impart. These benefits flow from six key characteristics of manufacturing as an economic activity.

Role of Manufacturing in Technical Change

A key element in the economic significance of manufacturing is its disproportionate importance in the conduct of Research and Development (R&D). R&D is crucial for product and process innovation, and expanding exports and import-substitution activity. The literature on the economics of technical change over the last two to three decades has focussed almost exclusively on manufacturing industry, due to its central role in innovation and its overwhelming share of total R&D expenditures (Australian Business Foundation Limited 1997:7.5). It is now widely accepted that R&D is an essential element in the maintenance of the competitiveness of a nation and its industries (Pianta 1998). World exports are increasingly 'knowledge intensive' (the share of R&D in manufacturing value-added is increasing over time) and the fastest rate of growth in merchandise exports is in these knowledge intensive industries (Sheehan *et.al.* 1995).[3] It is exactly in these sectors, referred to as Extensively Transformed Manufactures (ETMs), that Australia's trade deficit has been growing rapidly (Department of Foreign Affairs and Trade 2000:Table1). Table 2 demonstrates the significant role of manufacturing industry in private business R&D investment. In 1996-97 manufacturing industry undertook 59 per cent of total business R&D in Australia.

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3 Knowledge intensity can be measured in numerous ways, such as R&D expenditures as a share of value-added or professional-technical staff as a share of total employees.

Table 2: Australian R&D Expenditures X Industry, 1996-97

Industry	Expenditure ($ millions)	Per cent of Total
Mining	546	13.2
Manufacturing	2434	59.0
Wholesale & retail	201	4.9
Finance & insurance	94	2.3
Property & business services	514	12.5
Scientific research	152	3.7
Other	183	4.4
All Industries	**4124**	**100.0**

Source: Research & Experimental Development. All Sector Summary, ABS 8112.0

In countries such as Japan, Germany and the U.S.A., which have a much larger share of manufacturing in GDP, manufacturing industry accounts for up to 80 per cent of all private R&D expenditures. Moreover, the overall share of business R&D in GDP is more than double that of Australia (Department of Industry Science and Tourism 1996:72-75). The primary reasons for the higher share of R&D in GDP is not only the larger share of manufacturing in GDP, but these countries have a higher proportion of those sectors within manufacturing that are particularly R&D intensive. These sectors include, pharmaceuticals, electronics, aircraft, motor vehicles, scientific and medical equipment.

Whilst R&D is concerned primarily with the generation and adaptation of new knowledge, another key element in technical change is the diffusion of new and existing knowledge through vocational training. Manufacturing industry plays a particularly important role in the provision of industry funded 'structured' training in the Australian economy.[4] Both expenditure on training per employee and hours of training per employee are above the average for industries in Australia (ABS *Employer Training Expenditure Australia 1996*, 6353.0, Tables 3.4 and 3.8).

4 The ABS defines 'structured' training as 'All training activities which have a predetermined plan and format designed to develop employment-related skill and competencies' (ABS 6353.0:35).

A wider view of the notion of the production and diffusion of technical change than that of R&D is provided by estimates of expenditure on innovation. Based on definitions of innovation agreed within the OECD (known as the *Oslo Manual*) it has been found that manufacturing industry has a particularly high propensity for innovative activity. Technological innovation encompasses activities within the firm such as R&D; design; acquisition of licenses, patents and trademarks; new plant and equipment embodying new technology or enabling introduction of new products or processes; and marketing of new products etc. In 1994 R&D comprised about 35 per cent of total expenditure on innovation in manufacturing. Table 3 summarises the results of ABS surveys of innovation across industries. Manufacturing firms are three times more likely than other industries to engage in technological innovation and significantly more likely to engage in non-technical innovation.

Role of Manufacturing in Productivity Growth

Increasing output per worker and real incomes depend on the capacity of the economy to generate productivity growth. Manufacturing represents only 14 per cent of Australian output, but accounts for 50 per cent of all productivity growth in the market sector of the economy (Industry Commission 1997:Tables 5.2-5.3). In other words, 50 per cent of the long-run growth of living standards (increase in output per worker) is generated by manufacturing industry. This high contribution to productivity growth is a function of the relatively high rate of productivity growth in manufacturing and the comparatively large share of GDP represented by this industry. The capacity of manufacturing industry to generate high productivity growth for the economy has been recognised by the Industry Commission. 'Many of the activities of manufacturing (and the resource sectors) have been more amenable to productivity rises through new technologies and new production techniques than has been the case for some services' (Industry

Commission 1996:23).[5] Table 4 indicates the long-run productivity performance of industries in Australia. Manufacturing, with productivity growth of 2 per cent per annum, has the third highest productivity performance of all the industries listed.

A key factor in this productivity growth has been advances in technology brought about by R&D and innovation undertaken by manufacturing. Other reasons for the high levels of productivity in manufacturing include the existence of increasing returns, both static and dynamic. Increasing returns are reductions in a firm's or industry's unit costs of production as the output of the firm or industry increases. Static returns (otherwise known as internal economies) relate to the size and scale of production units and are a characteristic largely of manufacturing, but also apply to transport and storage industries (Kaldor 1966; Pratten 1971; Brennan 1998). Dynamic economies refer to increasing returns brought about by 'learning by doing' and 'learning by using', and external economies such as an increase in the progressive division of labour

5 The Industry Commission 1996, however, argues that high productivity is not in itself a reason for selective support to an industry. To argue this case the Commission relies on the distinction between technical efficiency and allocative efficiency. It equates the former with firms operating on their production possibility frontier and with productivity differences across industries, and the latter with an allocation of factors 'matched to their highest value uses'. Further, 'it is apparent that there is not a one to one correspondence between technical efficiency of an industry and the value attaching to the products/services which it produces. If there was, then the economy would only comprise firms and industries with relatively high levels of technical efficiency... Production of some products/services by firms/industries with relatively low levels of technical efficiency is both feasible and appropriate (particularly when it is not economic to import) because users are prepared to attach a value to them which makes their production profitable' (Industry Commission 1996:63). This attempt to use general equilibrium reasoning against selective assistance to manufacturing is faulty, because in general equilibrium there are no differences in productivity levels across industries or firms, as reflected in the assumption that the same factor receives identical returns across all uses. The description of an economy with an hierarchy of productivity levels across firms and industries (and presumably, different returns to identical factors across uses) is not only realistic, but can readily justify selective interventions. This is the case if assistance results in the establishment/maintenance of industries which have (i) productivity higher than the average industry and (ii) the cost of the assistance is less than the benefits afforded by the assisted industry.

across industries as aggregate output increases (Rosenberg 1982; Toner 1999:8-20).

Table 3: Firms Undertaking Innovative Activity as a Percent of Total Firms Within Each Industry. Australia. June 1994.

Industry	Technological	Non-Technological
Mining	9.7	28.5
Electricity, gas & water	17.2	45.4
Construction	7.9	10.8
Manufacturing	33.7	24.2
Wholesale	18.0	25.9
Retail	12.8	7.2
Accommodation, cafes, rests.	10.6	15.9
Transport & storage	6.5	12.9
Communication	20.9	18.2
Finance & insurance	7.0	11.0
Property & business services	11.4	14.6
Education	17.0	23.1
Health & community services	10.4	16.4
Cultural & recreation services	19.9	17.6
Personal & other	9.2	15.4
All industries	**11.5**	**14.0**

Sources: *Innovation in Australian Manufacturing 1994* (ABS Cat. No. 8116.0. Table 2); and *Innovation in Selected Australian Industries 1994* (ABS Cat No. 8118.0. Table1).

An essential element in the division of labour is the overcoming of indivisibilities in the employment of capital equipment, as an increase in output permits the employment of more efficient capital intensive production methods. (The increase in efficiency is due firstly, to increased mechanisation and use of more specialised equipment and secondly, to the more rapid depreciation and replacement of older equipment with more technically advanced plant). Growth in a firm's or industry's output also overcomes indivisibilities associated with 'sunk costs' such as R&D and marketing. The existence of increasing returns in manufacturing, in which growth of manufacturing industry's output causes a growth of manufacturing productivity, is sometimes referred to as Verdoorn's Law. This Law, which has received impressive empirical

support, states that a 1 per cent increase in manufacturing output will cause approximately a .5 per cent increase in manufacturing productivity. The increase in productivity reflects increasing returns caused by an increase in industry output. This law has been investigated by the Bureau of Industry Economics and has been found to apply in Australia (BIE: 1985).

Table 4: Multifactor Productivity Growth by Industry, 1974-75 to 1994-95

Industry	Productivity Growth, 1974-75 to 1994-95 (%)	Industry's Contribution to Aggregate Annual Productivity Growth (%)
Agriculture	1.2	7
Mining	-0.2	-1
Manufacturing	2.0	50
Electricity, Gas & Water	2.9	11
Construction	0.6	6
Wholesale trade	0.1	2
Retail trade	0.5	5
Accommodation, cafes & rest.	-1.3	-4
Transport, storage & commun.	3.3	26
Cultural & recreational servs.	-1.4	-3
All Industries (Market Sector)	**1.2**	**100**

Source: Industry Commission (1997), Assessing Australia's Productivity Performance, Tables 5.2 and 5.3.

Many other industries, such as Accommodation, Cafes and Restaurants; Personal Services; Retail; and Cultural and Recreational Services, have low or even negative productivity growth. Although these service industries have very limited productivity growth, they are increasing their share of GDP and employment (Tables 4-5). This highlights the fact that structural change (that is, shifts in the industry composition of output) does not *necessarily* result in higher levels of productivity or output per person across all industries. This is evident in Table 5 in which many of the industries with the fastest rate of employment growth have the lowest level of gross product per person. This is a crucially

important point, which is not sufficiently recognised by advocates of market-based structural adjustment. The whole *raison d' etre* of policies based on structural change, in conformity with the principles of comparative advantage, is that a re-allocation of resources arising from market-induced change in industrial structure will lead to a higher level of output per person than under a different system of resource allocation.

The significance of these trends is that many of the industries which are increasing their share of employment and GDP have low absolute levels of output per employee and low productivity growth. (Examined in the next section). This changing industrial structure imposes constraints to overall productivity growth and the growth of real income for the economy as a whole. Had manufacturing maintained its higher share of GDP of around 20 per cent from the mid-1980s it is probable that Australia would have experienced higher long-run productivity growth.

Manufacturing's Indirect Contribution to Productivity Growth

Another crucial aspect is that much of the output of manufacturing is not directly consumed by consumers, but is capital goods and intermediate inputs which enter into the production process of other industries' output. These capital goods and intermediate products embody continually improving technologies, which improves the efficiency and quality of user industries. Economic historians have long recognised that 'much of the technical change of the last two centuries or so has been generated' by capital goods producers (Rosenberg 1982:71). There is also a considerable body of economic thought, including Wassily Leontief (1963) and John Cornwall (1977), which has given prominence to the role of this sector in growth. This perspective regards the capital goods sector as:

> ... an instrument of generation and diffusion of new technological capabilities. Capital goods are the carriers of embodied technology in other sectors of the economy. This vital aspect has been confirmed in a number of recent studies relating to technology flows in industrial market economies. It has been shown that these flows are vital to productivity growth throughout the economy' (Baark 1991:905).

Some examples of these flows include more efficient jet engines which raise payloads and reduce costs in the transport industry; improved fertilisers and animal health products which raise yield per acre in agriculture; and improved digital telecommunications equipment which lowers real costs in the telecommunications industry. It is arguable that a large share of the productivity growth evident in transport, agriculture and utilities, for example, is attributable to embodied technical improvements in manufactured inputs to these industries. Capital goods are also at the core of the 'knowledge economy', in that it is continual improvements in the precision, speed and quality of machines used to produce micro-processors that has permitted rapid increases in computer processing power and reduced cost. In addition, manufacturing industry as a user and producer of high technology products and processes stimulates sophisticated service activities, such as computer software development for engineering and inventory control.

Moreover, whilst access to imported capital goods is essential, it is equally important to maintain a domestic capital goods base, given the necessity to adapt overseas equipment to domestic production requirements. There is also increasing evidence on the localised nature of learning and efficiency gains in the capital and intermediate goods sector. This latter phenomenon is known as 'leaning by using' and encompasses the two-way flow of knowledge between users and producers of capital goods (Rosenberg 1982:121-122; Porter 1990:554-555). These 'geographically localised' interactions are a major source of competitive advantage for manufacturers and users (Fagerberg 1998:208-225).

Manufacturing is also central to productivity growth through its role in work organisation reform, broadly defined. Not only has manufacturing been central to work organisation innovation, such as the creation of the 'factory' system. It is of continuing importance through its role in generating practices such as Just in Time (JIT) delivery and inventory control, Quality Assurance (QA), flexible specialisation and 'team-based' production. These innovations have subsequently been adopted in many industries outside of manufacturing.

Table 5: Employment and Productivity 1996-97, (1989-90 dollars). Australia

	Industry Gross Product ($ billions)	Employment 1996-97 (000)	Industry Gross Product per Person Employed ($'000)
Agriculture	17.5	427.0	41.0
Mining	19.3	86.7	223.6
Manufacturing	61.1	1129.8	54.1
Electricity, Gas & Water	14.2	66.7	214.0
Construction	29.0	586.8	49.5
Wholesale trade	46.2	492.5	93.9
Retail trade	31.6	1237.7	25.6
Accomm., Cafes, & Restaurants	8.2	399.1	20.7
Transport & Storage	25.4	396.2	64.4
Communication	17.6	163.6	107.7
Finance & Insurance	26.0	316.8	82.2
Property & Business Serv.	37.0	827.5	44.8
Govt. Admin & Defence	15.4	369.1	41.9
Education	19.1	581.9	33.0
Health & Community Serv.	23.4	771.6	30.4
Cultural & Recreation Serv.	9.2	192.5	48.1
Personal & Other Services	8.1	317.4	25.8
Total *	**409.3**	**8362.9**	**48.9**

* The total figure is the sum of each industry's gross product and excludes the other components of GDP- ownership of dwellings, import duties, and adjustment for imputed bank service charges. The total GDP figure including these items is $449.544 billion.

Table 5 (Cont.): Employment and Productivity 1996-97, (1989-90 dollars). Australia

	Share of Employment 1996-97 (%)	Employment Change 1984-85 to 1996-97 (%)	Contribution to Employment Change 1984-85 to 1996-97 (%)
Agriculture	5.05	1.72	0.43
Mining	1.05	-12.22	-0.74
Manufacturing	13.46	-0.24	-0.17
Electricity, Gas & Water	0.81	-50.60	-4.24
Construction	7.08	23.43	6.84
Wholesale trade	5.91	16.98	4.37
Retail trade	14.90	36.95	20.46
Accomm., Cafes, & Restaurants	4.67	73.04	10.03
Transport & Storage	4.76	10.20	2.24
Communication	1.98	8.28	0.77
Finance & Insurance	3.82	14.17	2.41
Property & Business Serv.	9.83	87.41	23.33
Govt. Admin & Defence	4.43	14.15	2.79
Education	7.00	29.78	8.17
Health & Community Serv.	9.23	41.20	13.71
Cultural & Recreation Serv.	2.24	50.15	3.81
Personal & Other Services	3.76	43.43	5.79
Total *	**100**	**24.47**	**100.00**

Source: *Australian National Accounts* (5206.0) and *Labour Force, Australia* (6203.0).

Manufacturing and High Living Standards

It is well established that there is a close correlation between differences in inter-industry wage levels and inter-industry differences in productivity or output per worker (Lowe 1995:126). Table 5 indicates that not only does manufacturing have above average levels of real output per employee, but many of those industries with some of the lowest levels of productivity per employee have made the largest contributions to long-run employment growth.

The Retail industry, for example, contributed over 20 per cent of employment growth between 1984-85 and 1996-97, but has a level of output per employee around half that of manufacturing. These results in part reflect the comparatively large proportion of part-time employees in many service industries.

Controlling for this effect by examining inter-industry differences in hours worked reveals similar large differences in earnings. For example, as at May 1998, total average earnings per hour for full-time adult non-managerial employees in the Retail; and Accommodation, Cafes and Restaurant industries were $14.27 and $13.67, respectively. This compares to $17.40 in manufacturing and $18.57 for all industries. (Derived from ABS 6306.0 1998: Table 17). Average full-time adult non-managerial hourly earnings in manufacturing were 18 per cent larger than for Retail and 22 per cent larger than for Accommodation Cafes and Restaurant industries. Retail and Accommodation, Cafes and Restaurant industries combined made up more than 30 per cent of the growth in employment between 1984-85 and 1996-97.

The combination of rapid growth of those industries with either relatively low or high output per worker coupled with a decline in middle level industries, such as manufacturing, has contributed significantly to growing earnings differentials in Australia. Long-run job loss in manufacturing has exacerbated these differentials, as 'there is a tendency for manufacturing employment to be concentrated in middle earning jobs'(Gregory 1993:68). Data covering the period 1976 to 1990 found that, of the 70,000 male jobs lost in manufacturing, there was a 'concentration of middle job loss in middle [income] quintiles'(Gregory

1993:68). More recent studies have found that within manufacturing the largest job losses have occurred in those industries, such as Machinery and Equipment, which have employees with the highest earnings in manufacturing industry (Fahrer and Pease 1994: Tables 3 and 5).

Other research has examined the relation between change in industrial structure and the demand for different levels of skill. There has been a bifurcation in the labour markets of developed economies with a large increase in the demand for highly skilled labour and a growing proportion of the workforce in lesser-skilled jobs with static or falling incomes (Reich 1991; Wood 1994). One study in Australia found that, over the period 1993 to 1999, employment shares of high and low-skilled occupations have increased and there was a marked decline in the share of middle skill occupations.[6] There has been a large increase in employment growth of professionals and associate professionals at one end and elementary and intermediate clerical, sales and service workers at the other (Cully 1999:101). One reason for this bifurcation in the labour market in terms of skills and earnings growth is a decline in the absolute number of middle level skill jobs in manufacturing. Other factors include reduced middle level employment in public administration and public utilities. Private sector 'down-sizing', such as that occurring within the finance and insurance sector, has also reduced middle level clerical and management occupations. The significance of this hollowing out of middle level skills is that much of the:

> employment growth in Australia between 1985-86 and 1996-97 has been occurring in industries that pay relatively low wages and...have low skill bases. Most of the employment growth appears to have been in industries such as accommodation, cultural and recreation and personal services, all of which pay relatively low average wages' (Department of Industry Science and Technology 1999:28).

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6 Middle skill levels include tradespersons, advanced clerical and service workers. The basis for skill comparisons is the Second Edition of the Australian Standard Classification of Occupations (ASCO), which explicitly uses a notion of skill based either on qualifications as defined within the Australian Qualifications Framework or a period of on the job work experience required for proficiency in a particular occupation (Cully 1999).

Manufactures, the Terms of Trade and the Current Account

It has long been recognised that the prices of agricultural and mineral commodities have a strong long-run tendency to decline against manufactures (Prebisch 1950). This is due to a range of factors including lower income and price elasticity of demand for commodities compared to manufactures; development of synthetic substitutes; and increased efficiency in the use of primary inputs which has significantly reduced commodity input and energy usage per unit of output in manufacturing and other industries.

Whilst there has been a significant increase in the proportion of ETMs in Australia's exports over the last ten years, agricultural and mineral commodities are still dominant, comprising 56 per cent of total Australian merchandise exports in 1998-99. Imports of manufactures comprised 86 per cent of the total value of merchandise imports, and 88 per cent of manufactured imports were ETMs (Department of Foreign Affairs and Trade 2000: Table 1). Long-run estimates of the terms of trade (ratio of export to import prices) for Australia over the period 1901 to 1987 indicate that 'over the century the terms of trade have declined at an annual rate of 0.4 per cent' (Schedvin 1987:26). Other estimates by the International Monetary Fund indicate that over the period 1964-1992 Australia's terms of trade declined by 45 per cent (Genoff and Green 1998:33).

The economic significance of declining terms of trade is that a larger volume of commodities needs to be exported to purchase a fixed value of imports. Declining terms of trade effectively represent a decline in National Income as more resources must be devoted to purchase a given value of imports. Secondly, it has been argued that, had the relative price of Australia's export commodities not declined over the last 2-3 decades, Australia's current account deficits would not have been nearly as severe. 'If Australia's terms of trade had mirrored the OECD average, Australia would have generated a current account balance outcome as good as, if not better, than the OECD average. Australia's terms of trade must be the central focus of attention' (Brain 1992:47). A larger manufacturing sector would contribute to halting the long-run decline in Australia's

terms of trade, and reduce Australia's large trade deficit on manufactures through increased exports and import substitution (Larcombe and Brain 1998: 63-81; Sheehan *et.al.* 1994).

Whilst the Industry Commission accepts that declining terms of trade represents a fall in 'the purchasing power of Australians (real income)' it adopts a remarkably benign view as to its economic significance. It does not regard adverse terms of trade as a significant policy issue because the fall in income is 'more than offset by improvements in productivity' (Industry Commission 1996:58). This relaxed view stands in contrast to a considerable body of orthodox economic literature which has identified adverse terms of trade as a source of welfare loss. For example, the possibility of 'immiserating growth' has been identified where growth in a country's exports leads to a decline in its terms of trade such that 'the loss from worsened terms of trade outweighed the primary gain from growth' (Bhagwati 1987). Moreover, empirical research into the issue of 'export-led growth' over the last three decades has identified the fact that 'the composition of exports affects economic growth' in that there is a 'negative correlation between the rate of growth rate of GDP and stage one exports' [Stage one exports are unprocessed agricultural and mineral commodities] (Dodaro 1991:1161).

Import and Export Elasticities

Estimates of import and export elasticities from Federal Treasury's macro-economic model of the Australian economy, the TRYM model, show additional problems with Australia's industrial and trade structure. The income elasticity of demand for imports with respect to the growth of domestic demand is 1.6. In other words, a 1 per cent increase in domestic demand results in a more than proportionate increase in the volume of imports. Australia's non-commodity exports have a unitary elasticity with respect to GDP growth amongst the nation's major trading partners. A 1 per cent increase in the GDP of Australia's trading partners results in a 1 per cent increase in non-commodity exports (Commonwealth Treasury 1996). The lower overall income elasticity of demand for Australian non-commodity exports largely reflects the predominance of Simply Transformed Manufactures (such as basic steel

and alumina) in non-commodity merchandise exports. The volume of commodity exports is assumed to be determined by their supply. This is particularly the case for agricultural commodities which have volatile supply conditions. Australia thus has a built–in structural deficit in merchandise trade. Not only does Australia have a propensity to import a greater *volume* of goods than it exports, but the unit *value* of Australia's exports is also in decline through falling terms of trade.

The decline in Australian manufacturing's share of domestic consumption of manufactures identified previously has resulted in massive trade deficits in manufactures and related services (including, transport and insurance). In 1998-99 Australia had a trade deficit of $56.1 billion in manufactured products (Department of Foreign Affairs and Trade 2000: Table 1). This trade deficit is equivalent to 340,000 jobs (based on direct employment multiplier for manufacturing derived from ABS 5246.0:Table 3).

Balance of Payments Constraint to Growth

In addition to the direct loss of employment, these trade deficits in manufacturing place a 'brake' on economic growth and the capacity to reduce unemployment. The advocates of this view, arguing mostly from a Kaldorian perspective, focus on the need to maintain a large and dynamic manufacturing base. This is due to manufacturing's capacity for significant exports or import-substitution, so as to avoid a 'balance of payments constraint to growth' (Cornwall 1977; Blackaby 1979; McCombie and Thirlwall 1994; Rowthorn and Wells 1987; Rowthorn 1997). It is a feature of most developed countries that they have both a high income elasticity of demand for imports and low price elasticity for imports. Countries that permit their manufacturing base to decline, consequently, tend to experience rising trade deficits in manufactures. Low price elasticity for imports implies that devaluation is not a medium term solution to excessive imports (Kaldor 1981; BIE 1985). The only way to reduce rising trade deficits and achieve balance of payments equilibrium (excluding industry policy interventions) is to reduce the rate of economic growth. In other words, adverse balance of payments impose a constraint on the rate of growth and the capacity to raise

national income and reduce unemployment. Lower growth rates, in turn, result in a cumulative decline in competitiveness, due to a slower rate of growth of increasing returns and technical innovation (the Verdoorn effect in reverse), which further worsens the balance of payments constraint (McCombie and Thirlwall 1994).

Manufacturing and the Role of Services

Cohen and Zysman (1986) have argued there are fundamental flaws in the argument that the role and significance of manufacturing industry is in rapid decline, being replaced by a new service-based economy. Many economic activities currently classified to services and supplied to manufacturing industry, such as transport of raw materials and finished products, engineering, computing, legal and accountancy activities were originally undertaken within manufacturing enterprises. With the growth of the economy and the progressive division of labour across firms and industries these activities are undertaken by specialised firms outside of manufacturing. This process has accelerated over the last two decades with large firms contracting-out an increasing proportion of activity (Industry Commission 1996:23).

Many of these service based firms, however, remain heavily dependent on demand from manufacturing. For example, 33 per cent of the intermediate demand for services from the Transport and Storage industry is from manufacturing. It is also the largest single user of services from private scientific establishments, engineering and computer consultancy firms. Manufacturing accounts for 21 per cent of the intermediate demand for the output of these firms (ABS Cat. No. 5209.0 1993-94: Tables 5 and 2). These latter service firms are also key generators and diffusers of new technology.

Daniels (1993) highlights the complementarity between the growth of manufacturing and high value-added services. For example, the sale of complex capital or computer equipment is frequently accompanied by engineering and technical staff involved in installation, maintenance and upgrading, as well as associated freight, insurance and technology royalties. The substantial international trade in manufactures can only

occur with the assistance of services provided by lawyers, accountants and the financial services industry. Multinational manufacturing firms have an important role in promoting their 'home' country service sector, especially in industries such as construction, transport, insurance, finance and business services. Large exports of manufactures and the establishment of overseas production facilities directly creates opportunities for exports of services. Typically, the links between domestic manufacturers and finance, insurance, engineering, construction and other business services companies are retained when a domestic manufacturer establishes overseas production facilities (Seymour 1987). It is no accident that many of the countries with the largest share of world trade in manufactures also have a large share of world trade in services.

There is no clearer link between manufacturing and services than the computer industry. Rapid improvements in the manufacturing capacity of micro-processors have greatly increased the computing power of these 'chips'. In turn, this feeds directly into the development of new programmes to exploit this enhanced processing power. This has led to the creation of new service industries such as, multi-media and mobile phone communications, which did not exist even 10-20 years ago.

Manufacturing Industry's Linkages With the Economy

Analyses such as those above highlight the continuing central role of manufacturing industry as both a key source of inputs for other industries and a key source of demand for the output of other industries. In other words, manufacturing has strong economic linkages or purchasing and supply relations with other industries. These linkages are measured through input-output analysis.

Table 6 shows the demand for intermediate inputs for each of the four industries. Intermediate inputs are purchases of inputs by one industry from other industries' output. Intermediate goods are those that enter only into the production process and are not directly consumed. The Table shows that manufacturing industry has the highest level of demand per unit of output for the goods and services of other domestic industries.

(The Table is based on direct allocation of competing imports, which relates only to domestic production and excludes imports). For example, to produce $100 of manufacturing output requires $55 of output from other domestic industries, including from manufacturing industry itself.[7] This data indicates 'that manufactures are more integrated with other parts of the Australian economy than are mining, services and agriculture' (Industry Commission 1996:16).

Table 6: Intermediate Inputs per $100 of Output. 1992-93

Agriculture	Mining	Manufacturing	Services
43.4	34.6	55.1	35.4

Source: Industry Commission 1996: Table 2.3. The table is based on direct requirements coefficients by industry with direct allocation of imports.

The economic significance of these closer linkages with other industries is that every dollar of manufacturing output generates more activity and jobs in the economy compared to a dollar increase in the output of other industries. Table 6 measures direct or first round effects. Successive rounds of activity induced by an increased output from a particular industry are measured through multiplier analysis. Manufacturing industry has total output multiplier effects 20 per cent and 25 per cent larger than that of agriculture and mining, respectively (ABS 5246.0; derived from Table 5). This analysis also implies that a stimulus generated initially in, say, tourism will be larger for the whole economy the larger the share of manufacturing industry in the economy. There is also some debate that the conventional method of calculating multipliers under-estimates the multiplier effect of industries, such as manufacturing and construction, which have a large share of their output classified as investment goods (Hirschman 1958:95).[8]

7 Aside from the goods and services purchased from other industries, that is intermediate inputs, the other major elements of an industry's output within an input-output framework are Gross Operating Surplus (Gross profits) and wages.

8 Hirschman (1958) originally proposed the view that the conventional method of multiplier analysis under-estimated the effect of an initial expansion in final demand due to the fact that investment, like all other components of final demand, was deemed to be exogenous, and therefore excluded from multiplier analysis.

The comparatively high import penetration in manufacturing products in Australia reduces the multiplier effect of manufacturing industry, as a large share of inputs are sourced from overseas. The multiplier effects from manufacturing in other countries which have a lower import penetration, such as Japan, are much greater than in Australia.

Conclusion

Arguments that manufacturing industry has a particularly important role in growth and development are frequently criticised as a modern form of Physiocracy (Industry Commission 1996:71). However, as the evidence reviewed in this paper indicates, there are a number of reasons why manufacturing matters. A range of readily available Australian empirical data has been identified which strongly supports the central role of manufacturing in the growth of *per capita* output. It is concluded this data supports the necessity to maintain a large and competitive manufacturing base.

The view that manufacturing industry has a special role in growth does not imply that other industries are unimportant. Indeed, from eighteenth century political economy to the present, advocates of the central role of manufacturing industry have emphasised the increasing interdependence of the economy, through the mechanism of the division of labour. The view that manufacturing is an 'engine of growth' not only has a central place in the history of economic thought, but also impressive support in development economics (Chenery *et.al.* 1985;Weiss 1984), the economics

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8. (cont'd): Given the well-established Keynesian finding that change in the level of investment is determined by demand, investment may be viewed as endogenous. Further, some proportion of the annual investment of a given industry may be viewed as contributing directly to the output of the current year's production or indirectly contributing through replacement of depreciating assets.Given that virtually all investment goods (defined in the system of National Accounts as productive assets with an economic life exceeding 12 months) are supplied by the manufacturing and construction industries it follows that the inclusion of the value of industries' investment in multiplier calculations would, among other effects, increase the value of forward linkage between these two industries and the rest of the economy.

of technological change (Australian Business Foundation Limited 1997) and the macro-dynamics of modern capitalist economies (Toner 1999).

The question of how best to nurture and promote an efficient manufacturing sector then becomes the key policy question. Due to the importance of the growth of demand in increasing the efficiency and productivity of manufacturing, ensuring access to markets must be *the* foundation of industry policy. The domestic market offers considerable scope for expansion of local manufacturing, given the large and sustained growth in imported manufactures over the last three decades.

An example of an existing cost-effective mechanism which could well be expanded is the Industrial Supplies Offices (ISO). The ISO identifies the capability of local firms in terms of technology, equipment and skills, and liaises with purchasers of manufactures and related services to ensure that, where feasible, these purchases are sourced from local firms. Government purchasing policies can also facilitate access to multi-billion dollar markets. The NSW Government, for example, spends $10 billion on goods and services annually and has decided to use this spending power to assist industry development by requiring all contracts for goods and services valued at more than $1 million be channelled through the ISO (NSW Government 1999). Import-replacement strategies must also be complemented with export promotion.

The analysis in this paper also highlights policies that promote Research and Development; the diffusion of innovation; fostering linkages (networks and clusters) between producers of capital and intermediate goods and the users of these goods to facilitate learning and market growth; and improvement in workforce skills.

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