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Impact of international trade on employment: Evidence from Australian manufacturing industries

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Abstract

Manufacturing employment in Australia has been on a long-run declining trend over the past four decades. It is a widely held view that import competition, especially from low wage countries, is an important factor driving this trend. Low-wage countries have indeed significantly increased their collective share of Australia's imports of manufactured goods. The results also indicate that manufactured imports have a statistically significant negative relationship with manufacturing employment. Exports, on the other hand, have the opposite effect. Trade's role in employment determination, however, has waned over time. A key, albeit tentative, result of the empirical analysis is that trade and wage elasticities of labour demand are likely related in a way that trade imposes a discipline on labour markets.

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Key points

- **Manufacturing employment in Australia has declined both in absolute and relative terms over the past four decades.**
- **Employment decreased in all industries except food, beverage and tobacco manufacturing (FBT). Job losses have been severe in textile, clothing, footwear and leather manufacturing (TCF) and machinery and equipment manufacturing (M&E).**
- **Manufactured goods dominate Australia's import basket; on average, over 80 per cent of Australia's imports by value are manufactured goods.**
- **At present, around half of Australia's manufactured imports by value are sourced from low-wage countries—up from less than 10 per cent four decades ago.**
- **Our panel data analysis finds that trade has a significant impact on employment, although the intensity of the impact varies by industry and has lessened over time.**
- **We also find that employment in industries immune from foreign competition is less responsive to wages.**

1. Introduction

Manufacturing employment in Australia has declined both in absolute and relative terms over the past four decades. Australian manufacturing industries employed more than 1.3 million persons in 1971, accounting for about a quarter of total employment. However, manufacturing employment fell to about 929,000 persons — to be 8.4 per cent of total employment — in 2012. As such, employment in manufacturing has shrunk by a third in absolute terms, while total employment doubled. Most other advanced economies have had a similar experience. For example, by 2012, manufacturing employment in the United States contracted by a third of its 1971 level and the manufacturing share of total employment decreased by 15.7 percentage points.[1]

It is a widely held view among the Australian manufacturing businesses[2] and workers[3] that import competition, especially from low-wage countries, has significantly contributed to the challenges faced by this sector. Similar sentiment persists in both policy circles[4] and popular media. In addition, the real appreciation of the Australian dollar and the outpacing of labour productivity growth by real wage inflation have also been mentioned by commentators as potential determinants of the loss of competitiveness, and hence jobs, in Australian manufacturing industries. Both of these latter developments are fairly recent whereas the absolute decline in manufacturing employment is a longer-term phenomenon.

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[1] Source: OECD STAN database and Australian Bureau of Statistics.

[2] For example, in a survey of 100 senior executives from a range of Australian manufacturing firms, conducted in 2013 for *The Australian* newspaper, it was found that 32 per cent (highest) respondents regarded *cheap overseas labour/goods* as the main impediment to growth in their sector. In addition, *high Australian dollar* and *foreign competition* were reported as obstacles to growth by 21 per cent and 17 per cent of the executives, respectively. When asked what their biggest concerns were for the next 5–10 years, 25 per cent (highest) respondents noted *competition from Asia/overseas* as such. Moreover, 64 per cent of the respondents thought the high Australian dollar had a either negative or very negative impact on their sector, while 83 per cent of the executives thought *Australian labour costs were too high relative to skills and productivity*. See: http://resources.news.com.au/files/2013/08/12/1226695/673246-aus-bus-file-p2p-manufacturing-graphs.pdf

[3] The Australian Manufacturing Workers Union claimed in a 2007 report,en titled *The potential employment impacts of an Australia-China free trade agreement*, that over 170,000 manufacturing jobs will be lost if such a trade agreement, which the then government was contemplating, were signed. See: http://www.amwu.org.au/content/upload/files/report/China-FTA-Report-0407.pdf

[4] For example, the Federal Government established an anti-dumping commission in 2012 in order "to protect Australian manufacturing jobs from cheap imported products". Julia Gillard, then Prime Minister, reportedly promised that the changes in anti-dumping provisions would provide "stronger protection for Australian industry and manufacturing … against unfair competition from overseas". See: http://www.heraldsun.com.au/news/victoria/pm-declares-war-on-super-cheap-imports/story-e6frf7kx-1226529219944

On the one hand, the link between import competition and domestic employment *may* appear straightforward. To the extent that imports substitute domestically produced goods, if imports displace domestic production then, for a given level of demand, employment in the industry in question can be adversely affected — with wage adjustments dampening the employment response. The magnitude of the employment and wage effects will depend on the nature of the labour market, and on the wage-setting mechanism.

On the other hand, the precise effect of import competition on sector-specific employment adjustments remains unclear for a number of reasons. Firstly, when imports do not compete against domestic production, they cannot plausibly have an adverse effect on employment[5]. Secondly, it can be difficult to calculate the effect of imported intermediate or producer goods on domestic manufacturing employment.[6] Thirdly, at higher levels of per capita income, consumer preferences shift away from manufactures. As such, productive resources are reallocated from manufacturing to services and imports in this case may no longer compete against domestic production, and can be viewed as an 'effect' rather than a 'cause'.[7] Fourthly, a sudden upward shift in the external demand for natural resources can lead to a steep increase in the terms of trade of a resource exporting country. With a floating nominal exchange rate, the higher terms of trade in turn leads to real exchange rate appreciation; and hence erodes the competitiveness of the tradable sector. Thus, establishing a direct causal link between imports and manufacturing job-loss is less straightforward for an economy affected by the *Dutch disease*[8]. Indeed, owing to a surge in Asia's demand for Australia's iron ore and coal, Australia's terms of trade rose very steeply since 2002 and peaked in 2011. Meanwhile, Australia's real effective exchange rate appreciated more than 60 per cent compared to its level in 1995. Thus, an analysis of trade-related employment adjustments during a period of rising commodity prices would require taking such additional factors into account.

The purpose of this paper is to investigate the nature of the relationship between import competition and manufacturing sector employment in the

[5] Imports can be non-competing when, for example, domestic production is absent due to either the completion of product life-cycle or lack of capacity.

[6] Considering only manufactured intermediates, and not unprocessed raw materials, imported intermediates (upstream goods) are expected to boost domestic production of downstream goods; but this implies the production of the intermediates is displaced. The net effect on employment will depend on the respective labour input requirement per unit of output of upstream and downstream goods.

[7] Hine and Wright (1998) point out that while the UK manufacturing output remained stagnant during the 1980s, a period when the UK manufacturing employment declined rapidly, manufactured imports remained 'buoyant'. The authors, hence, question if the supposed shift in domestic demand away from manufacturing is valid.

[8] See Corden (1984) for a discussion of *Dutch disease* economics.

context of Australia.[9] The remainder of the paper is organised as follows. A brief review of the literature linking import competition and changes in manufacturing employment is provided in section 2. Patterns of Australia's trade in manufactures as well as production and employment trends in the Australian manufacturing industry are reviewed in section 3. Section 4 provides a description of the data used for analysis and explains the econometric techniques used in the paper. Results of econometric analysis as well as their limitations and their sensitivity to changes in model specification are discussed in section 5. Concluding remarks consisting of directions of future research and policy implications along with a summary of the paper are presented in the final section.

2. Import competition and manufacturing employment

The economic literature investigating the drivers of the decline in manufacturing employment in advanced countries has considered, among other factors, the role of import competition from low-wage countries. There are both theoretical and practical bases for doing this. The Heckscher-Ohlin model of international trade suggests trade between labour-abundant (hence low-wage, e.g. China) and labour-scarce (hence high-wage, e.g. Australia) countries would lead to contraction of labour-intensive industries in the latter. Even if such trade promotes expansion of capital-intensive industries in high-wage countries, job losses in labour-intensive industries will almost certainly be larger than job gains in capital-intensive industries. Therefore, aggregate manufacturing employment will fall. Further, the practical reason for suspecting import competition from low-wage countries to be a 'cause' of manufacturing job-loss in high-wage countries rests on the timing of these events. That is, the continuation of large net loss of manufacturing jobs in advanced economies overlaps well with their continued large imports of manufactures from populous developing countries.

This section briefly reviews the literature that has taken a predominantly labour economics perspective on the effect of international trade on labour markets. The primary emphasis is on the work published mostly during the 1990s on the impact of trade on manufacturing workers. The labour market consequences of trade came under scrutiny by labour economists since the early 1990s. This was fuelled by the events of the 1980s, which saw dramatic upheavals in North American labour markets together with an increased sensitivity of the US economy to foreign pressures. A key event of the 1980s was the 1980–85 Volker fight against inflation that led to an appreciation of the US dollar by 35 per cent, and to a trade deficit of unprecedented magnitude.

Another important development during the 1980s was the significantly slower growth in average real wages in a number of industrialised countries. In

[9] We do not have ANZSIC-based trade data disaggregated by trading partners for the whole period under purview, where ANZSIC stands for Australia New Zealand Standard Industrial Classification. Hence, we use ANZSIC-based total trade data.

addition, the wedge between skilled and unskilled wages widened. This increased wage dispersion, which has been associated with increased income inequality, was particularly evident in the US and the UK, but was quite evident in other Organisation for Economic Cooperation and Development (OECD) countries as well, including Australia[10]. Given the coincidence of developments such as these, it is not surprising that labour economists identified international factors as crucial for explaining these trends. For example, Murphy and Welch (1992) and Wood (1994) attempted to link the labour market developments during the 1980s to increasing penetration of advanced-country markets by exports of manufactured goods from labour-abundant developing countries. The labour economics literature spawned by these events is selectively and briefly reviewed in the remainder of this section, for it sets the stage for the evidence presented from Australia in the following sections.

There is a long history of research into the effects of trade flows on employment. The regression-based studies in the labour economics literature suggest that trade flows have a large impact on employment. Setting aside differences in research design, the main conclusions are: (i) exports have a large and positive impact on employment, (ii) imports have a large and negative impact on employment, (iii) higher import prices lead to higher employment, and (iv) trade flows and import prices have a more pronounced impact on employment than on wages.

Employment responses to trade are consistently found to be larger than wage responses to trade. This feature is identified in studies that estimate both wage and employment equations, for example Grossman (1987), Abowd and Lemieux (1991), Freeman and Katz (1991), and Revenga (1992). Thus, changes in employment tend to be the dominant adjustment factor in the labour market. This picture is altered when attention is confined to union workers. Gaston and Trefler (1995) show that in response to changing tariffs and imports, union workers make much greater wage adjustments than their non-union counterparts. In a competitive labour market, the dominant adjustment factor must be employment: workers respond to lower wages by switching industries. However, unions are in a position to accept lower wages in return for employment guarantees. Increased product market competition translates into increased labour market competition and eroding union-non-union wage differentials.

Krugman (1995) sets up a Computable General Equilibrium (CGE) model to explore the employment impact of increased trade with developing countries. He argues that with rigid relative wages of unskilled and skilled labour, increased imports of unskilled-labour-intensive products will have two components. The first is the standard factor content effect from an increase in net imports of unskilled-labour-intensive products. This is supplemented by a general equilibrium multiplier effect whose magnitude depends on the level of net exports of skilled-labour-intensive products and the unskilled to skilled ratio in aggregate employment. The combined effect is double that of the

[10] See Davis (1992) and OECD (1993) for international comparisons. Borland (1992) provides findings for Australia.

usual factor content estimate alone. However, the impact on employment of increased trade with developing countries remains small — an estimated 1.43 per cent fall in employment from an import penetration rate for manufactures from the *newly industrialising economies* (NIEs) of 1.75 per cent of OECD GDP (1998 level).

Some empirical analyses find that export-oriented industries pay higher average wages than import-competing industries do in the US[11]. This means increased trade flows have been associated with increased employment in high-wage manufacturing industries and decreased employment in low-wage manufacturing industries. Thus, Dickens and Lang (1988, p.78) noted that 'it appears that trade is eliminating low-wage jobs and creating relatively high-wage jobs'. In contrast, by comparing within-industry and between-industry employment effects, Berman et al. (1994) concluded that trade has not had a significant impact on labour-intensive manufacturing industries.

Since the early to mid-1980s, there has been concern over *deindustrialisation*[12] in many advanced countries. The concern is that the continuing shift out of manufacturing and into the service sector is linked to increased import competition, and that cheap foreign labour is stealing domestic manufacturing jobs[13]. Abowd and Freeman (1991) argued that the decline in manufacturing employment means that fewer workers are now exposed to international competition than was previously the case. Nevertheless, deindustrialisation remains controversial. The manufacturing sector, in particular, has had to adjust to the rapid onset of changes in technology. Technological progress has been identified as the leading candidate for explaining the structural shift from manufacturing to services and the increasing income inequality (for males, in particular) described above. Unfortunately, the difficulties with the policy implications of deindustrialisation are analogous to the difficulties of the policy implications of inter-industry wage differentials[14]. In the latter case, it is contentious whether high wages are a feature of the industry, as predicted by efficiency wage models, for instance, or whether high wages are due to unobserved worker-sorting that attracts high productivity workers to high-growth industries. If high wages are an industry characteristic then deindustrialisation may be a real concern: losing jobs in high-wage industries amounts to lowering average wages. On the other hand, if high wages reflect the high unobserved quality of workers employed in these industries then deindustrialisation is less worrisome. As high-quality workers are forced to switch to new industries, they will raise both productivity and wages in their destination industries.

[11] See, for example, Dickens and Lang (1988); Katz and Summers (1989).

[12] Thirlwall (1982) defines *deindustrialisation* simply as the absolute decline in manufacturing employment, due to any cause whatsoever.

[13] See, for example, Revenga (1992) and Wood (1994).

[14] See, for example, Krueger and Summers (1988) and Gaston and Trefler (1994b).

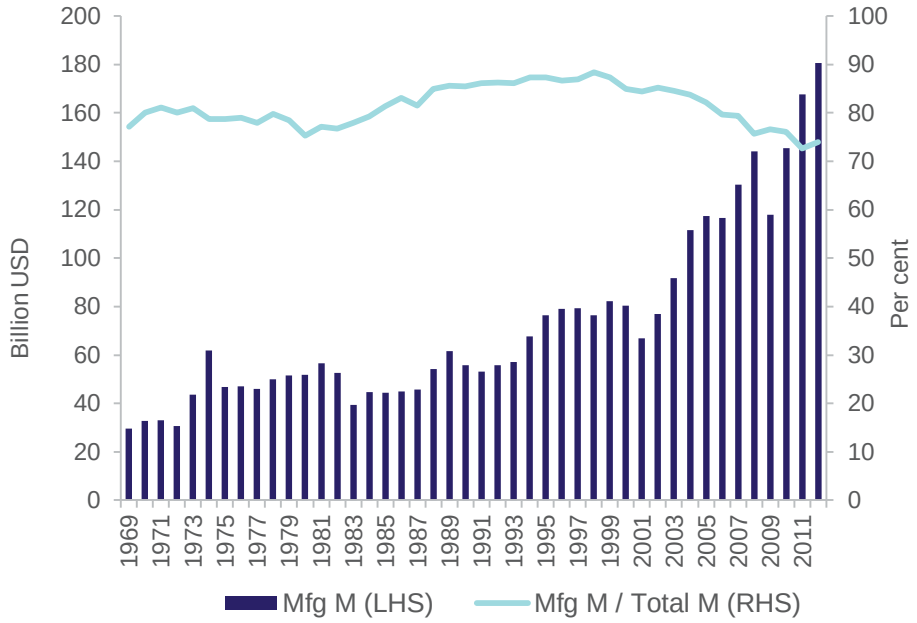
3. Trade, production and employment in Australian manufacturing

Manufactured goods dominate Australia's import basket. Figure 3.1 shows Australia's real imports of manufactures grew very strongly over the past decade[15] while the share[16] of manufactures to total imports has remained *above* 70 per cent in *any* year of the past four decades, with the period average being 81 per cent. As such, Australia's imports of manufactured goods as a share of its total imports have remained not only high but also relatively stable for a significantly long period.

[15] Average annual value, in constant 2011–12 prices, of imported manufactures was $55.2 billion during 1969–2002, but jumped to $132.4 billion for the decade to 2012. Note that China's production and export of manufactures increased sharply following its World Trade Organization accession in 2001, which in turn led to a steep increase in China's demand for Australia's resources—mainly iron ore and coal. As a result, Australia's terms of trade rose to unprecedented levels and the real exchange rate appreciated significantly during the past decade.

[16] The share is based on current price data.

Figure 3.1: Australia's manufactures imports and its share of total imports, 1969–2012[17]



Source: Author's calculation based on UN Comtrade data.

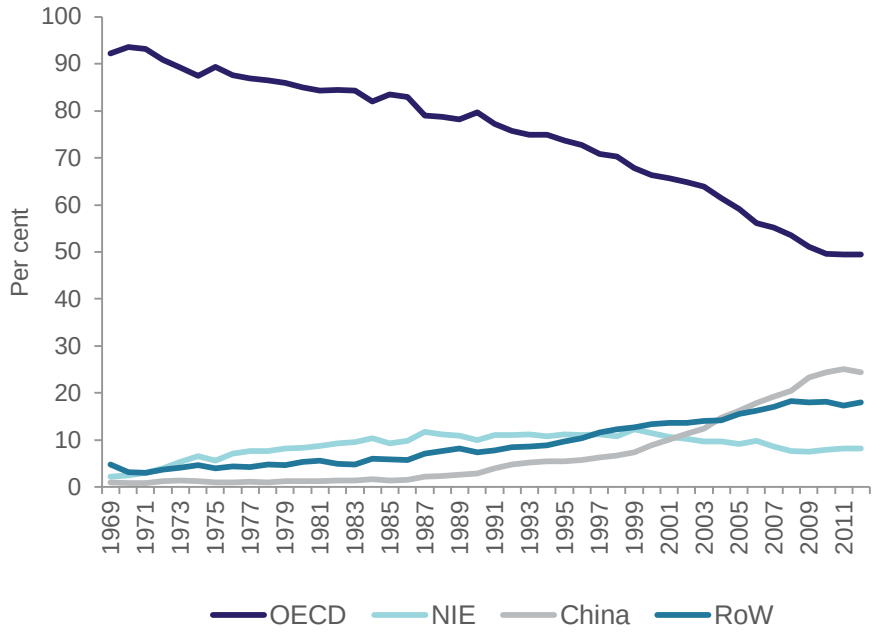
What have changed noticeably though are the *sources* of Australia's imports of manufactured goods. In 1969, advanced countries (OECD)[18] accounted for over 90 per cent of Australia's manufactures imports whereas the four *newly industrialising economies* (NIEs) of Hong Kong, Singapore, South Korea and Taiwan supplied about 2 per cent. China's share of Australia's market was below 1 per cent, while the rest of the world (RoW) accounted for less than 5 per cent. These shares at present are dramatically different from what they were four decades ago. In 2012, about a quarter of Australia's manufactures imports by value were sourced from China, while the OECD share was

[17] For the purpose of Figure 1, manufactured goods are defined as commodities falling under Section codes 5 (Chemicals), 6 (Manufactured goods classified chiefly by material), 7 (Machinery and transport equipment) and 8 (Miscellaneous manufactured articles) of the Standard International Trade Classification (SITC), Revision 1. International trade data by SITC, beginning in 1962, are compiled by the United Nations Statistics Division. SITC is a commodity-based, as opposed to an industry-based, classification. Hence, there are numerous manufactured commodities that fall under SITC Section codes 0 (Food and live animals), 1 (Beverages and tobacco), 2 (Crude materials, inedible, except fuel), 3 (Mineral fuels, lubricants and related materials) and 4 (Animal and vegetable oils and fats). However, the former group of commodities is generally referred to as *manufactures*, since it represents the bulk of the value of world trade in manufactures. If the import values of the manufactured goods belonging in the latter group were included in the calculation, then the ratios in Figure 1 would be even higher. Hence, the point made by Figure 1 prevails despite this simplification.

[18] In this paper, the terms *advanced countries* or *OECD countries* refer to the group of countries which were members of the OECD prior to 1994 minus Turkey. This group is generally termed, *developed countries* (Krugman 2008).

reduced to half. The rest of the world, at 18 per cent, also gained significantly, while the NIE share, which peaked at around 11 per cent on average during the 15 years to 2002, was 8 per cent in 2012. Figure 3.2 shows the average proportions of Australia's manufactures imports accounted for by these sources during 1969–2012.

Figure 3.2: Shares of major sources of Australia's manufactures imports, 1969–2012[19]



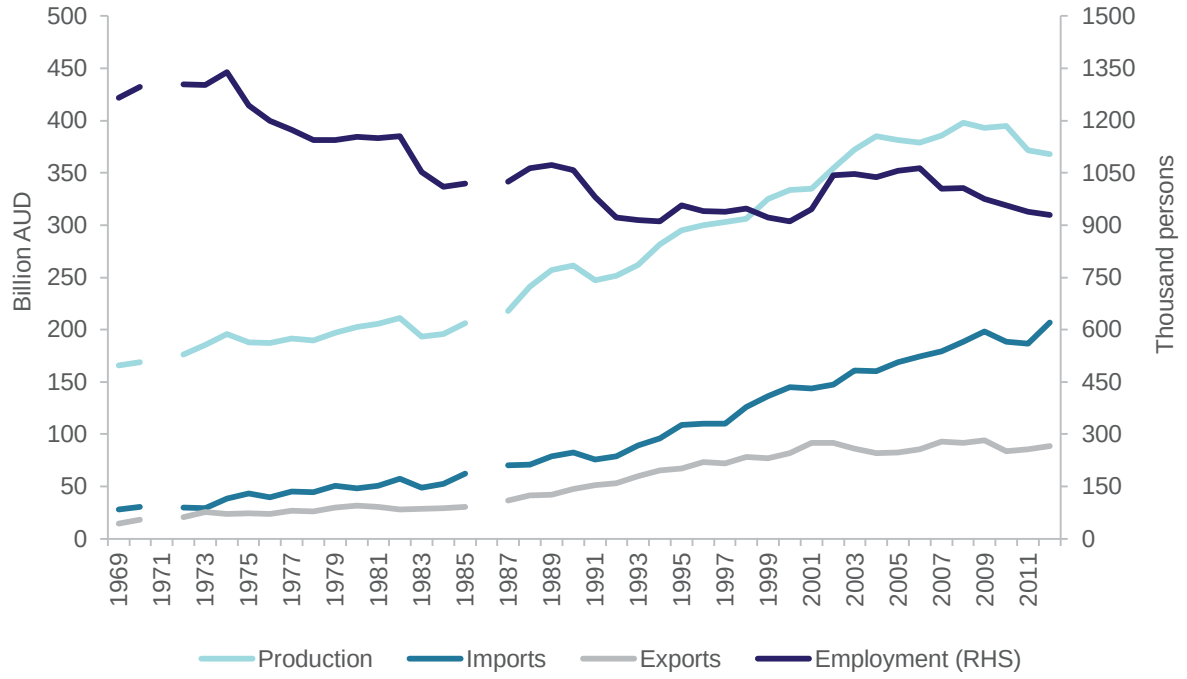
Source: Author's calculation based on UN Comtrade data.

Such dramatic source-switching from high-wage (OECD) to low-wage (China and RoW) countries for imports of manufactures, even with a fairly stable share of manufactures to total imports, reminds the Heckscher-Ohlin prediction that trade between countries of very different factor endowments will lead to contraction of import-competing sectors in those countries. Thus, Australia's observed trade patterns provide a basis for hypothesising that manufacturers in a labour-scarce, high-wage country like Australia may find imports from labour-abundant, low-wage countries (e.g. China) difficult to compete against—especially so in case of labour-intensive industries.

Figure 3.3 reveals trends in Australia's manufacturing output, employment and trade flows for more than the past four decades. Manufacturing output, while becoming more than twice as large in real terms over 40 years, has become a much smaller proportion of national output. Real imports and exports of manufactures, meanwhile, have grown sevenfold and sixfold, respectively.

[19] Figure 2 is based on current price data, and uses the same definition of manufactured goods as Figure 1.

Figure 3.3: Australia's manufacturing output, employment and trade flows, 1969–2012



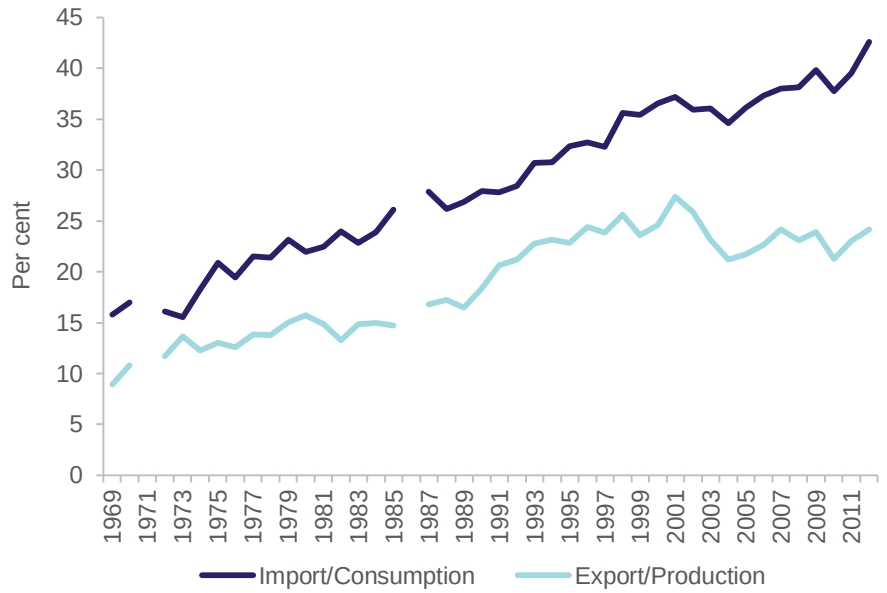
Source: Productivity Commission (PC) and Australian Bureau of Statistics (ABS).

Note: Output and trade data are in constant 2011–12 prices.

With the exception of a major downturn during the recession of 1991, output growth was relatively steady between 1983 and 2008. However, manufacturing output has been falling in absolute terms since 2008. On the other hand, the number of employed persons in the Australian manufacturing industry has been declining non-monotonically since the mid-1970s, with the latest rebound occurring by the turn of the century. However, employment in absolute terms started falling again since 2006. In contrast, import growth has been steady and generally faster than export growth during the whole period. Moreover, exports appear to have remained stagnated since 2001. As such, the manufacturing trade deficit has been largely widening.

Figure 3.4 shows the importance of imports as a share of domestic consumption has been steadily increasing over time. The *import penetration ratio* more than doubled over the past four decades — from 16 per cent in 1969 to 43 per cent in 2012. On the contrary, the export share of domestic production — also known as *export propensity ratio* — has stagnated since reaching a peak of 27 per cent in 2001. Moreover, besides being generally larger than output, consumption also grew faster than output on average.

Figure 3.4: Import-to-consumption and export-to-production ratios, 1969–2012



Source: Author's calculation based on data from PC and ABS.

Figures 3.3 and 3.4 show that while imports have been increasing both in absolute and relative terms, exports have stagnated on both accounts. As such, Australian manufacturers have been unable to increase the share of output exported over the past decade while chronically losing the domestic market share to imports. These developments overlap well with the long-run decline in manufacturing employment.

Aggregate trends hide the differences that exist among individual manufacturing industries in their patterns of trade, production and employment. As Table 3.1 shows, the extent of job losses differed substantially across 2-digit ANZSIC 1993 manufacturing industry subdivisions[20]. Employment decreased in all industries except *food, beverage and tobacco manufacturing (FBT)* which employed nearly a quarter of a million workers on average during 2009–12. On the other hand, job losses have been severe in *textile, clothing, footwear and leather manufacturing (TCF)* and *machinery and equipment manufacturing (M&E)*. These two industries jointly accounted for over four-fifth of all manufacturing jobs lost between 1969–72 and 2009–12. Thus, manufacturing job losses, although widespread, were concentrated in the TCF and the M&E industries. This also shows that the decline in manufacturing employment was not limited to labour-intensive or low-technology industries.

[20] Australian and New Zealand Standard Industrial Classification (ANZSIC) was adopted in 1993. According to ANZSIC 1993, there are nine *subdivisions* (2-digit industries) within the manufacturing *division*. Prior to 1993, Australian Standard Industrial Classification (ASIC) was in use, while a revised edition of ANZSIC is in use since 2006.

Table 3.1: Trade, production, employment and wages in Australian manufacturing industries, 1969–72 and 2009–12[21]

Industry	*Employment (000 persons)*			*Production (billion A$)*			*Production (billion A$)*			*Imports (billion A$)*			*Exports (billion A$)*			*Import penetration (%)*			*Export propensity (%)*		
	1969-72	**2009-12**	**%Δ**	**1969-72**	**2009-12**	**%Δ**	**1969-72**	**2009-12**	**%Δ**	**1969-72**	**2009-12**	**%Δ**	**1969-72**	**2009-12**	**%Δ**	**1969-72**	**2009-12**	**Δ**	**1969-72**	**2009-12**	**Δ**
FBT	193.7	240.5	24.2	39.1	99.3	154.0	33.9	50.3	48.4	1.1	10.7	872.7	8.8	17.7	101.1	3.4	11.6	8.2	22.4	17.9	–4.5
TCF	186.2	45.1	–75.8	15.1	6.7	–55.6	26.6	37.2	39.8	3.3	10.5	218.2	1.0	1.9	90.0	18.8	69.1	50.3	6.4	29.2	22.8
WPP	87.0	66.5	–23.6	12.6	21.0	66.7	33.2	57.4	72.9	1.9	4.4	131.6	0.2	2.2	1000.0	13.4	18.9	5.5	1.5	10.6	9.1
PPR	74.3	46.5	–37.4	4.9	8.3	69.4	36.4	52.6	44.5	0.6	2.3	283.3	0.1	0.4	300.0	11.1	22.2	11.1	1.4	5.3	3.9
PCC	109.7	98.3	–10.4	18.7	77.9	316.6	39.6	74.6	88.4	5.2	43.1	728.8	0.7	11.6	1557.1	22.5	39.3	16.8	3.9	14.9	11.0
NMP	51.0	42.3	–17.1	7.1	16.1	126.8	39.9	67.5	69.2	0.7	2.0	185.7	0.1	0.2	100.0	8.5	11.3	2.8	0.8	1.5	0.7
MPM	206.0	179.6	–12.8	32.9	82.0	149.2	38.7	62.4	61.2	2.2	22.1	904.5	4.8	35.9	647.9	7.3	33.0	25.7	14.7	44.5	29.8
M&E	337.5	199.4	–40.9	35.8	63.4	77.1	37.4	63.6	70.1	14.2	93.3	557.0	2.0	16.2	710.0	29.6	66.4	36.8	5.5	25.5	20.0
OTH	42.9	39.3	–8.4	3.8	7.2	89.5	30.6	37.8	23.5	0.5	6.7	1240.0	0.2	1.8	800.0	11.5	55.5	44.0	6.4	25.1	18.7
ALL	1288.4	949.8	–26.3	170.1	382.0	124.6	35.2	58.3	65.6	29.6	195.1	559.1	17.9	88.0	391.6	16.3	39.9	23.6	10.5	23.1	12.6

Notes: Titles and codes of ANZSIC 1993 Subdivisions of the Manufacturing Division:

FBT: Food, beverage and tobacco (21); TCF: Textile, clothing, footwear and leather (22); WPP: Wood and paper products (23); PPR: Printing, publishing and recorded media (24); PCC: Petroleum, coal, chemical and associated products (25); NMP: Non-metallic mineral products (26);
MPM: Metal products (27); M&E: Machinery and equipment (28); OTH: Other (29).

Source: Author's calculation based on data from PC and ABS.

[21] Production, imports, exports and wage rate are in 2011–12 prices. 1969–72 denote the average for the period. Wage rate is annual. Import penetration is import-to-consumption ratio while export propensity is export-to-production ratio. Abbreviations of ANZSIC 1993 Subdivisions

Real output of all industries except TCF increased, albeit at wide ranging rates. TCF is the only industry to generate lower output in 2009–12 than four decades earlier. Generally, above-average increases in output are associated with below-average decreases in employment. However, both the rise in output and the fall in employment were slower than average in *wood and paper products manufacturing (WPP)* and *other manufacturing (OTH)*. On the other hand, it is less clear how changes in trade flows relate to changes in employment. It appears, however, that strong import growth did not lead to large scale job losses in industries that were initially small importers but large exporters.[22] In addition, very strong export growth prevented large scale job losses in large importers even when import growth was strong; *petroleum, coal, chemical and associated product manufacturing (PCC)* fits this description.

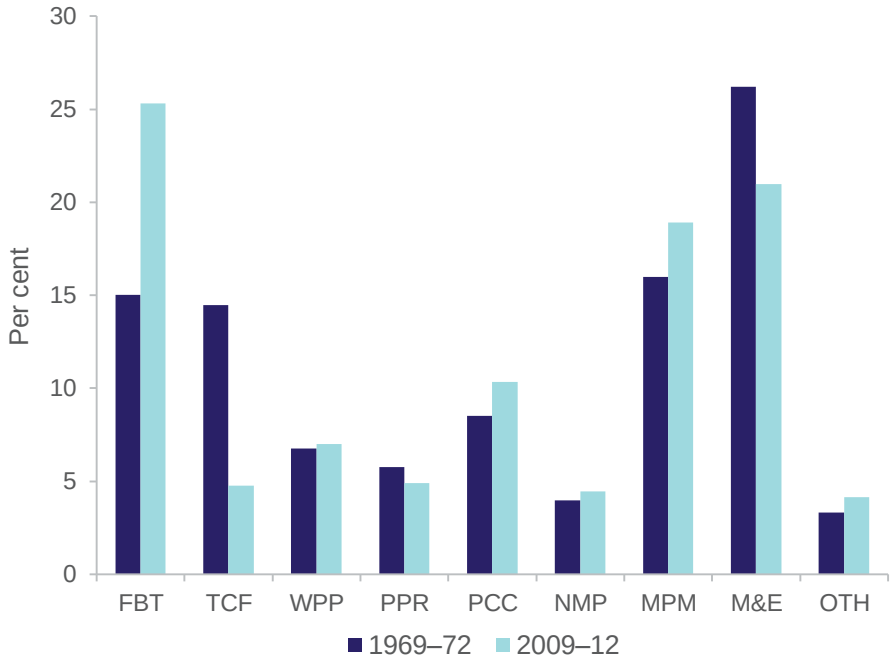
Compared to aggregate manufacturing, job losses have been less intense in PCC. Interestingly, the PCC wage rate not only grew most strongly but also was among the highest. Moreover, output of this industry more than quadrupled—highest proportional increase—in four decades. These features of PCC sharply contrast that of TCF which had the lowest wage rate, while wage growth in TCF has been among the weakest. Finally, these two industries differ markedly in terms of relative factor intensity; arguably, while TCF is one of the most labour-intensive industries, PCC is one of the most capital-intensive ones. Such contrast highlights the role of supply-side factors in driving structural change within the manufacturing sector.

Figures 3.5 and 3.6 show, for certain manufacturing industries, shares of employment and output have changed significantly. For example, while FBT's share in manufacturing employment rose from 15 per cent to 25 per cent, TCF's share fell from around 14 per cent to about 5 per cent.[23] Moreover, M&E share of employment decreased by over 5 percentage points during this period. On the other hand, PCC nearly doubled its share in total manufacturing output, while already large sectors of FBT and *metal products manufacturing (MPM)* increased their shares further. In contrast and in line with the change in employment share, M&E share of total output fell by about 4 percentage points. In addition, while shares of TCF and WPP in total imports of manufactures fell, PCC and MPM shares in total imports increased. On the other hand, FBT's share in total exports of manufactures fell from around 49 per cent to about 20 per cent. However, shares of PCC, MPM and M&E in total exports increased significantly. Shares of *printing, publishing and recorded media (PPR)* and *non-metallic mineral products (NMP)* in any aggregate quantity (for example, trade and production) changed little over four decades.

[22] If an industry accounts for a small share of total imports then it is a 'small' importer. Both FBT and MPM fit this description.

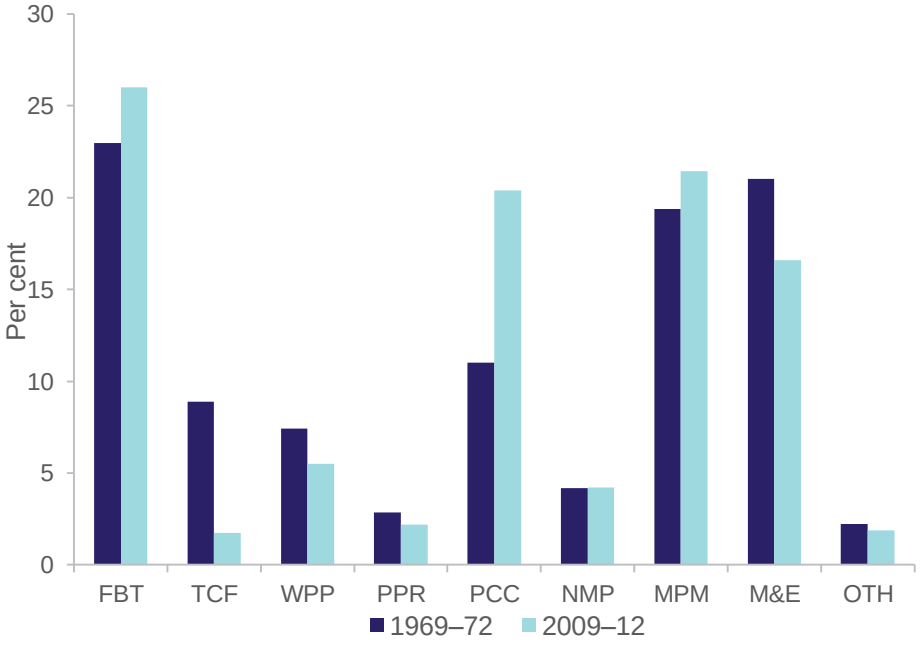
[23] This is consistent with the Heckscher-Ohlin prediction. FBT is agriculture-intensive, which in turn is land-intensive; while TCF is labour-intensive. Australia is land-abundant, but labour-scarce. Hence, increased trade is expected to lead to the expansion of FBT and the contraction of TCF in Australia.

Figure 3.5: Industry shares of manufacturing employment, 1969–72 and 2009–12



Source: Author's calculation based on data from PC and ABS.

Figure 3.6: Industry shares of manufacturing output, 1969–72 and 2009–12



Source: Author's calculation based on data from PC and ABS.

The intensity of Australia's manufactures trade increased significantly over the past four decades. This is evident by a significant increase of the aggregate import penetration ratio from 16.3 per cent to 39.9 per cent, and of the export propensity ratio from 10.5 per cent to 23.1 per cent. Import penetration as well as export propensity changed the least in industries that have links to Australia's natural endowments—such as, FBT and WPP.

FBT is also the only industry where the export share of domestic output declined between 1969–72 and 2009–12. Changes in these shares have also been minimal in industries with certain peculiarities in the nature and end-use of their products—namely, PPR and NMP. Although a systematic pattern of relationship between changes in trade shares and changes in employment is not readily apparent from Table 1, it appears that employment contraction was severe in industries where both the initial import penetration ratio and the increase in the same were above the average for aggregate manufacturing; both TCF and M&E fit this description. In addition, job losses have been less severe in MPM for which both the initial and the long-period change in export propensity were above the manufacturing average.

4. Methodology and data

Empirical studies of the effect of trade on employment have generally used one of the three following methodological approaches: factor content calculation; growth accounting; and regression-based labour demand estimation.[24] In order to avoid the limitations associated with the first two methods, this paper employs econometric modelling of labour demand.[25] A number of studies already discussed in the literature review section, including Gaston (1998) and Greenaway, Hine & Wright (1999), adopted this approach. Estimation of labour demand equations at the industry level involves regressing employment on a number of explanatory variables derived from standard labour demand framework.

Consider a modified equation of the derived demand for labour at the industry level, augmented by trade flow variables as well as other time-varying regressors controlling for macro or broad-sectoral movements:[26]

[24] Sachs and Shatz (1994) used factor content approach to estimate the effect on US manufacturing employment of increased imports from a set of developing countries. Krueger (1980) used the growth accounting framework to calculate the extent of job losses in US manufacturing accounted for by import competition. Hine and Wright (1998) used regression-based models of labour demand to study trade-related employment adjustments in the UK manufacturing. See Jenkins and Sen (2006) for a discussion of all three methodological approaches.

[25] See Greenaway, Hine and Wright (1999) for a discussion of the limitations of both the factor content and the accounting decomposition methods.

[26] (1) is a typical reduced-form employment equation used by the regression-based studies, as reviewed earlier, of the effect of trade on employment.

$$L_{it} = \beta_i + \beta_1 D_{it} + \beta_2 W_{it} + \beta_3 M_{it} + \beta_4 X_{it} + \boldsymbol{\alpha Z'_t} + v_{it} \quad (1)$$

where L_{it} is employment in industry i at time t. Similarly, D_{it} is real consumption, W_{it} is real wage rate, M_{it} is real imports and X_{it} is real exports.[27] $\boldsymbol{Z}_t$ is a vector of time-varying regressors that do not vary by industry, and includes controls for: (i) cyclical fluctuations (real GDP), (ii) opportunity cost of capital (policy interest rate), (iii) movements in non-labour input prices (manufacturing input producer price index), (iv) movements in real effective exchange rate (real trade-weighted index), and (v) residual/secular change over time not explicitly captured by any other explanatory variable (linear time trend).

All variables, except for the time trend, are in natural logarithm. Annual data[28] between 1969 and 2012 (hence T = 44) on nine manufacturing industries (hence N = 9) with some missing values are used for the regression analysis.

The model's intercept is allowed to vary by industry, and be correlated with industry regressors. Consistent estimation of the slope parameters in the fixed-effects model requires eliminating the β_i. Since panel unit root test reveal that each variable of the model is I(1), while their first difference is I(0), we use the first-difference (FD) estimator, which allows weak exogeneity of explanatory variables.[29] The random disturbance v_{it} is assumed to suffer from panel-specific AR(1) serial correlation, panel-level heteroskedasticity and contemporaneous correlation across panels.

Note that using the FD estimator when the original model has a linear time trend as a regressor necessitates inclusion of a common intercept. Moreover, following Freeman and Katz (1991) and Abowd and Lemieux (1991) in their treatment of the adjustment of earnings and employment to domestic and foreign demand shocks, consumption, imports and exports are scaled by total industry output.[30] The model is estimated for the *small N–large T* case.

[27] These are *industry* regressors. L_{it} is the number of employed persons in industry i in June of year t. Consumption is defined as production plus imports less exports. Consumption, imports and exports are in constant 2011–12 manufacturing output producer prices. Nominal wage rate is calculated by dividing total wages by the number of employed persons (L_{it}), and then expressed in 2011–12 consumer prices. Due to lack of ANZSIC-based trade data disaggregated by trading partners, we use ANZSIC-based total import-export data.

[28] Interest rate and exchange rate data are sourced from the Reserve Bank of Australia. GDP and input price index are sourced from the Australian Bureau of Statistics (ABS). Data on other variables from 1969 to 1989 are from the Productivity Commission, and from 1990 to 2012 are from the ABS. Pre-1990 industry data are in Australian Standard Industrial Classification, while post-2005 data are in Australia New Zealand Standard Industrial Classification 2006 (ANZSIC 2006). Industry data for the years 1990–2005 are in ANZSIC 1993. As such, all industry data are converted to ANZSIC 1993 using appropriate concordance tables sourced from the ABS.

[29] See Cameron and Trivedi (2010) for a discussion of the FD estimator and the weak exogeneity assumption for explanatory variables.

[30] Scaling ensures that relative magnitudes—as opposed to differences in absolute magnitudes—of consumption, exports and imports across panels are taken into account. See Gaston (1998) for details.

Although (1) implies explanatory variables have common impacts across industries, this assumption is relaxed later so that βs can vary by industry.

β_1 and β_4 are expected to be positive, since both domestic and foreign demand should boost production and employment. On the other hand, to the extent that imports displace domestic production, β_3 is expected to be negative. Since higher real wages tend to depress labour demand, β_2 is also expected to be negative. Moreover, cyclical fluctuations, *ceteris paribus*, tend to shift labour demand in the same direction. Lower employment may also be associated with: higher interest rate, higher non-labour input prices, and higher real exchange rate. Finally, if falling industrial employment is a structural feature of continued economic development in advanced countries then the linear time trend is expected to pick up any residual factor negatively associated with manufacturing employment.

5. Results and their sensitivities and limitations

Table 2 shows three sets of estimation results: Model 1 of Table 5.1 reports results of the base specification, Model of Table 5.1 reports results for the base specification augmented by the first lag of each explanatory variable and the lagged dependent variable and Model 3 of Table 5.1 reports results for base specification augmented by the interaction between real wage rate and real imports and real exports, respectively. Although the aim of the study is to explore if there is a direct relationship between trade and employment, the latter is included to investigate whether trade's impact on employment operates through the wage channel. [31]

[31] *Variables that vary by industry and by year: L* is employment, *D* is real consumption, *M* is real imports, *X* is real exports and *W* is real wage rate.
Variables that vary by year but not by industry: input_pr is manufacturing input producer price index, *reer* is index of real trade-weighted exchange rate, *int* is interest rate (the Reserve Bank of Australia cash rate target) and *gdp* is real GDP.

Table 5.1: Labour demand equations—homogeneous impact of regressors across industries

	Model 1		*Model 2*		*Model 3*	
	coeff	*p-value*	*coeff*	*p-value*	*coeff*	*p-value*
$\Delta \ln L_{t-1}$			–0.0231	0.851		
$\Delta \ln D_t$	0.2799	0.000	0.2928	0.000	0.2577	0.000
$\Delta \ln D_{t-1}$			0.0788	0.354		
$\Delta \ln M_t$	–0.2762	0.000	–0.2904	0.000	–0.2520	0.000
$\Delta \ln M_{t-1}$			–0.0906	0.300		
$\Delta \ln X_t$	0.3432	0.000	0.3626	0.000	0.2924	0.000
$\Delta \ln X_{t-1}$			0.0967	0.316		
$\Delta \ln W_t$	–0.5114	0.000	–0.5949	0.000	–0.5125	0.000
$\Delta \ln W_{t-1}$			–0.1438	0.280		
$\Delta \ln input\_pr_t$	0.0624	0.542	0.0375	0.744	0.0585	0.546
$\Delta \ln input\_pr_{t-1}$			0.0523	0.637		
$\Delta \ln reer_t$	0.0087	0.932	–0.0170	0.877	–0.0172	0.862
$\Delta \ln reer_{t-1}$			0.0336	0.762		
$\Delta \ln int_t$	0.0089	0.757	0.0007	0.983	0.0075	0.607
$\Delta \ln int_{t-1}$			0.0007	0.981		
$\Delta \ln gdp_t$	0.5509	0.164	0.4954	0.242	0.6078	0.108
$\Delta \ln gdp_{t-1}$			0.4036	0.360		
$\Delta \ln M_t * \Delta \ln W_t$					0.0507	0.738
$\Delta \ln X_t * \Delta \ln W_t$					1.3530	0.001
const	–0.0340	0.025	–0.0468	0.045	–0.0344	0.017
obs	331		312		331	
R^2	0.2052		0.2326		0.2322	
Wald chi^2	67.84		76.22		98.78	

Notes: (1) The dependent variable is $\Delta \ln L_t$ which is the first difference of natural log of industry employment. (2) $\Delta \ln D_{t-1}$ is the first lag of $\Delta \ln D_t$. (3) $\Delta \ln M_t * \Delta \ln W_t$ is the interaction between real imports and real wage rate. See footnote on the previous page for more details.

Source: Author's calculation.

As seen in Model 1 of Table 5.1, estimation results of the base model suggest that the effect of imports on employment is negative and statistically significant—a 10 per cent increase in imports is associated with a 2.8 per cent decrease in employment. On the other hand, a rise in exports of the same proportion is related to a 3.4 per cent rise in employment. As expected, the effect on employment of domestic consumption is positive and statistically significant, and of real wage rate is negative and significant. Employment increases by 2.8 per cent and decreases by 5.1 per cent, respectively, as consumption and annual real wage per worker increases by 10 per cent each.

Model 2 of Table 5.1 shows that lags of no variable, including the lagged dependent variable, are statistically significant. Hence, a dynamic model is not necessary. There is some suggestion in the literature that export-oriented industries pay higher than average wages, while import-competing ones do the opposite. Thus, Model 3 of Table 5.1 focuses on the interaction between trade volumes and real wages. Results suggest that while wage elasticity of employment remains unaffected by industry imports, the co-movement of exports and wages have a positive and statistically significant effect on industry employment. Exporting, by shifting up labour demand, likely offsets employment decreasing effects of higher wages. On the other hand, it is also possible that industries paying lower than average wages tend to contract due to shortage in labour supply, and hence import more to meet domestic demand.

The industry-invariant variables, controlling for macro or broad-sectoral movements, are not statistically significant. The coefficient of real effective exchange rate has the expected sign (negative)[32] in the specifications of Models 2 and 3, while that of real GDP has the expected positive sign in all the specifications. Theory suggests higher non-labour input prices would put downward pressure on output levels, thus decreasing employment. On the other hand, it was expected that higher interest rate, by reducing investment, would reduce employment. It is likely that if we could use industry-specific, as opposed to overall, measures of non-labour input prices and exchange rates then these regressors would demonstrate statistically significant relationship with industry employment. Nevertheless, coefficient estimates are relatively stable across the three different models presented in Table 2. Their magnitudes, signs and statistical significance do not vary widely across different specification.

As noted above, the bulk of the absolute decline in manufacturing employment over the past four decades is accounted for by only two industries: *textile, clothing, footwear and leather manufacturing (TCF)* and *machinery and equipment manufacturing (M&E)*. However, it has also been

[32] Higher real effective exchange rate should displace domestic production by making exports more expensive in foreign markets, and imports cheaper at the home market; and thus decrease employment.

highlighted that job losses did not remain limited to these two industries only. Therefore, analysis of the sensitivity of the estimation results requires that we estimate the model excluding these two influential industries to investigate if the adverse impact of imports on employment prevails without them.

Results shown in Model 4 of Table 5.2 indicate that imports destroy, while exports boost, jobs even in industries experiencing less severe job losses than TCF and M&E. Moreover, commentators have recently noted that Australian manufacturing is under more pressure since 2003 (the start of Australia's latest mining boom), and even more so since 2008 (the start of the latest global financial crisis). Models 5 and 6, respectively, of Table 5.2 show that the impact of imports on employment is no less severe in the years prior to 2003 and 2008 than it is for the whole period.[33] Nevertheless, in the pre-2003 subsample, the coefficients are larger in magnitude and the regressors explain more of the variation in industry employment. This suggests other factors affecting employment not explicitly captured by the model are possibly at play over the past decade.[34]

[33] To see this, compare Model 1 of Table 5.1, which shows the estimates of the base model, with the Models 5 and 6 of Table 5.2.

[34] Tables 6 and 7 in the appendix show other variations of the base model. For example, estimation results of a reduced model consisting of only the industry regressors and a constant, and of the reduced model with time dummies are reported in Table A.1. Moreover, two more labour demand equations (employment regressed on output and wages) are estimated; one excludes trade flow variables but includes macro or broad-sectoral regressors, while the other includes no variable except output and wages. Note that the latter is the textbook definition of a typical labour demand equation.

Table 5.2: Labour demand equations—sub samples

	Model 4 *excluding TCF and M&E*		*Model 5* *year < 2003*		*Model 6* *year < 2008*	
	coeff	p-value	coeff	p-value	coeff	p-value
ΔIn Dt	0.2753	0.001	0.3019	0.000	0.2861	0.000
ΔIn Mt	–0.2443	0.007	–0.3215	0.000	–0.2869	0.000
ΔIn Xt	0.3142	0.001	0.3403	0.000	0.3539	0.000
ΔIn Wt	–0.4882	0.000	–0.5411	0.000	–0.4417	0.005
ΔIn input_prt	0.0546	0.637	0.0470	0.566	0.0614	0.590
ΔIn reert	0.0070	0.953	0.0994	0.324	0.0457	0.719
ΔIn intt	0.0016	0.961	0.0188	0.430	0.0138	0.650
ΔIn gdpt	0.4433	0.330	0.6007	0.060	0.5615	0.192
const	–0.0284	0.095	–0.0263	0.045	–0.0343	0.051
obs	257		243		288	
R2	0.1691		0.4448		0.1698	
Wald chi2	47.93		77.20		49.48	

Note: The dependent variable is $\Delta \ln L_t$ which is the first difference of natural log of industry employment.

Source: Author's calculation.

In order to investigate whether coefficients are stable over time, the sample is split into pre- and post-1990 subsamples.[35] Notice in Table 5.3 that the coefficients of the key variables (industry regressors) vary widely, especially in their magnitudes. Smaller coefficients of trade variables for the post-1990 subsample vis-à-vis the pre-1990 likely suggest that the labour-intensity of Australian manufacturing sector has declined significantly over time; and hence, imports destroy, and exports create, less employment in recent decades than in earlier ones. In addition, for the latter half of the sample, the model is much less good at explaining the variation in industry employment and the coefficients of trade variables are less significant. This indicates that the role of trade in manufactures in determining employment may have declined over time. Finally, also notice that the post-1990 wage elasticity of labour demand is much larger than the pre-1990 wage elasticity. This possibly indicates decreasing rigidity of labour markets as a result of increasing overall liberalisation.

[35] Splitting the sample in the year 1990 allows us to see if the coefficients vary before and after the bulk of the 'microeconomic reforms' were implemented.

Table 5.3: Labour demand equations—coefficient stability over time

	Model 7 *year < 1990*		*Model 8* *year > 1990*	
	coeff	*p-value*	*coeff*	*p-value*
$\Delta \ln D_t$	0.4519	0.000	0.2255	0.028
$\Delta \ln M_t$	–0.4912	0.000	–0.2137	0.036
$\Delta \ln X_t$	0.5003	0.000	0.2851	0.016
$\Delta \ln W_t$	–0.2999	0.004	–0.5609	0.000
$\Delta \ln input\_pr_t$	0.1126	0.051	–0.0444	0.842
$\Delta \ln reer_t$	0.0886	0.205	0.0851	0.640
$\Delta \ln int_t$	0.0127	0.395	–0.0056	0.930
$\Delta \ln gdp_t$	0.2114	0.349	0.6559	0.401
const	–0.0349	0.000	–0.0321	0.317
obs	135		196	
R^2	0.6951		0.1583	

Note: The dependent variable is $\Delta \ln L_t$ which is the first difference of natural log of industry employment.

Source: Author's calculation.

Since different industries differ not only in terms of size, input-output and technology parameters but also in terms of the degree of international exposure, it would be an unnecessary oversimplification to assume that the impact of trade on employment does not vary by industry. Therefore, in order to investigate if trade impacts different industries differently, we allow the coefficients of key industry regressors to vary by industry. Table 5.4 presents estimation results when trade volumes and wages are interacted with industry dummies.[36] Model 9 shows that imports have no effect on the employment in *food, beverage and tobacco manufacturing (FBT)*. This is the only industry that has experienced significant job gains during the period of analysis. In addition, imports also have no effect on employment in *printing, publishing and recorded media (PPR)* as well as in *non-metallic mineral product manufacturing (NMP)*. Import volumes have strong and highly significant negative impact on employment in the rest of the industries.[37]

[36] This implies β_2, β_3 and β_4 are allowed to vary by industry by turn. The coefficient of domestic consumption (β_1) is also allowed to vary by industry, but nothing interesting is revealed other than the fact that its magnitude did vary by industry. However, β_1 turned out to be positive and significant for all industries.

[37] Note that the magnitude of the coefficient of import volume (β_2) is the largest for TCF and M&E. this is consistent with the fact that these two industries jointly account for about four-fifth of the total decline in manufacturing employment over the past four decades.

Table 5.4: Labour demand equations—heterogeneous impact of regressors across industries

	Model 9 *ΔIn Mt * industry*		*Model 10* *ΔIn Xt * industry*		*Model 11* *ΔIn Wt * industry*	
	coeff	p-value	coeff	p-value	coeff	p-value
ΔIn Dt	0.2898	0.000	0.3491	0.000	0.2789	0.000
ΔIn Mt			–0.3508	0.000	–0.2724	0.000
ΔIn Xt	0.3472	0.000			0.3381	0.000
ΔIn Wt	–0.5390	0.000	–0.5163	0.000		
ΔIn input_prt	0.0945	0.347	0.0838	0.395	0.0556	0.546
ΔIn reert	0.0810	0.449	0.0695	0.483	0.0573	0.540
ΔIn intt	–0.0008	0.980	–0.0021	0.945	0.0097	0.717
ΔIn gdpt	0.5389	0.204	0.5272	0.185	0.5405	0.139
FBT	0.0263	0.878	0.3983	0.000	–0.5641	0.001
TCF	–0.2923	0.000	0.4756	0.000	–0.7923	0.000
WPP	–0.2442	0.002	0.6828	0.000	–0.4643	0.001
PPR	–0.2072	0.146	0.9446	0.185	0.4511	0.283
PCC	–0.2913	0.000	0.4949	0.000	–0.4678	0.004
NMP	–0.1578	0.111	0.6799	0.059	–0.3252	0.081
MPM	–0.2765	0.001	0.3708	0.000	–0.5984	0.000
M&E	–0.2915	0.000	0.4436	0.000	–0.5018	0.008
OTH	–0.2507	0.003	0.5075	0.000	–1.9038	0.000
const	–0.0362	0.021	–0.0360	0.017	–0.0330	0.017
obs	331		331			
R2	0.2092		0.2214		331	
Wald chi2	77.54		70.47		0.3031	
ΔIn Dt	0.2898	0.000	0.3491	0.000	122.47	

Notes: (1) The dependent variable is ΔIn L_t which is the first difference of natural log of industry employment. (2) ΔIn M_t * *industry* is the interaction between real imports and industry dummies.

Source: Author's calculations

Model 10 shows that the positive employment effects of export volumes is either non-existent or very weak[38] for the same two industries of *printing, publishing and recorded media (PPR)* and in *non-metallic mineral product manufacturing (NMP)*. However, the effect of exports on employment in all other industries is positive and highly significant. Model 11 in Table 5 shows real wage rates have strong and negative impact on employment in all but the same two industries of *printing, publishing and recorded media (PPR)* and in *non-metallic mineral product manufacturing (NMP)*. Wage elasticity of labour demand is essentially zero for these two industries. This is a curious result, because this could mean there is a potential relationship between

[38] By 'very weak', it is meant that the statistical significance of the coefficient is above 5 per cent.

trade and wage elasticities of labour demand. In other words, industry employment being immune to foreign competition could imply the violation of the law of (labour) demand; i.e. trade likely has a disciplining effect on labour markets. If correct, then this result can also have implications for the dynamics of labour productivity growth relative to real wage growth in such industries.

While the conjecture based on the results presented in Table 5.4 requires more vigorous investigation, some other limitations of the study are as following. Although the coefficients are assumed to be stable over time, this assumption is later relaxed to find that their magnitudes vary significantly. In addition, while the dataset is a non-stationary panel, a traditional and widely used method (first-difference estimator) is employed instead of more modern estimators. This is done, firstly to improve the comparability of the study, and secondly because the latest methods dealing with non-stationary panels are an active area of research. On the other hand, the first-difference estimator—assuming the model error has panel-specific AR(1) autocorrelation, panel-level heteroskedasticity and contemporaneous correlation across panels—applied on a *small N–large T* dataset is expected to provide consistent estimates of the coefficients of model (1).[39] Nevertheless, panel unit root test confirms that the estimated residual is stationary; and hence, the postulated relationship between employment, consumption trade and wages is not a spurious one.

Furthermore, using trade data disaggregated by trading partners as well as industry-level covariates for exchange rates and non-labour input prices would improve both the appeal and the rigour of the empirical analysis. In addition, it would be preferable to control for labour productivity and capital stock while trying to model labour demand. Finally, simultaneity and endogeneity of the regressors have not been explicitly addressed in the paper. These are useful avenues for future research.

6. Conclusion

Manufacturing employment in Australia has been on a long-run declining trend. It is a widely held view that import competition, especially from developing countries, is one of the factors driving this trend. However, job losses intensified in the past decade, possibly due to the real appreciation of the Australian dollar, which in turn happened as a result of a sharp increase in Australia's terms of trade owing to a commodity price boom.

While over half of Australia's manufactures imports by value are currently sourced from low-wage countries, even without using trade data disaggregated by trading partner countries, we find that the relationship between imports and employment is negative and statistically significant. On the other hand, exports have the opposite effect on industry employment. Moreover, not only that trade's impact on employment varies by industry, preliminary results suggest industries with inelastic labour demand with respect to trade also demonstrate inelastic labour demand with respect to

[39] This is suggested by Cameron and Trivedi (2010).

wages. As such, it is likely that trade has a disciplining effect on labour markets.

Although imports impact employment negatively, more trade would be preferable to less for a number of reasons. Firstly, the positive effect of exports on employment is larger than the negative effect of imports on the same. Secondly, job losses in import-competing industries can be made up by job gains in export-oriented industries. Thirdly, trade imposes discipline on labour markets by helping to preserve the law of demand. Thus, increased trade can have a positive effect on labour productivity growth. On the other hand, lack of exposure to trade could lead to the outpacing of labour productivity growth by real wage growth.[40] Fourthly, although imports can impose short-run adjustment costs, trade in general is expected to increase overall national welfare in the long run.

Future research would benefit from more disaggregated (4-digit level) industry data. In addition, reasonable estimates of industry-specific input prices, exchange rates and traded goods as well as labour productivity and capital stock may be utilised in the labour demand equation. Moreover, imports and exports by source and destination can be used to identify if imports from low-wage countries are more detrimental to domestic employment compared to that from high-wage countries. Finally, instrumental variable regression techniques can be used to avoid problems related to endogeneity of regressors; for example, source-weighted industry-specific exchange rates will be used as proxies for import flows.

[40] Commentators as well as business lobbies complaining about the labour cost in Australia routinely refer to this as a reason for the claimed decline in Australia's competitiveness.

Appendix A

Table A1: Labour demand equations—reduced model with/without time dummies

	reduced model		*reduced model with time dummies*	
	coeff	*p-value*	*Coeff*	*p-value*
Δln D_t	0.3251	0.000	0.2616	0.000
Δln M_t	–0.3182	0.000	–0.2570	0.000
Δln X_t	0.3965	0.000	0.3391	0.000
Δln W_t	–0.4683	0.000	–0.4348	0.001
const	–0.0144	0.047	0.0367	0.000
obs	340		340	
R^2	0.1867		0.4007	
Wald chi^2	63.17		1908.08	

Notes: The dependent variable is Δln Lt which is the first difference of natural log of industry employment.

Source: Author's calculation.

Table A2: Labour demand equations—basic and basic with industry-invariant regressors

	basic		*basic with industry-invariant regressors only*	
	coeff	*p-value*	*Coeff*	*p-value*
Δln Y_t	0.2811	0.000	0.2436	0.000
Δln W_t	–0.4652	0.000	–0.5141	0.000
Δln *input_pr*$_t$			0.0652	0.500
Δln *reer*$_t$			–0.0388	0.694
Δln *int*$_t$			0.0196	0.481
Δln *gdp*$_t$			0.7109	0.056
Const	–0.0096	0.146	–0.0347	0.018
Obs	340		331	

Notes: (1) The dependent variable is Δln L_t which is the first difference of natural log of industry employment. (2) Δln Y_t is the first difference of natural log of industry output.

Source: Author's calculation.

References

Abowd, J. and Freeman, R., 1991. 'Introduction and Summary', in John M. Abowd and Richard B. Freeman (eds), *Immigration, Trade and Labor Markets* (Chicago: NBER), pp.1-25.

Abowd, J. and Lemieux, T., 1991. 'The Effects of International Trade on Collective Bargaining Outcomes: A Comparison of the United States and Canada', in John M. Abowd and Freeman, Richard B. (eds), Immigration, Trade, and Labor Markets (Chicago: NBER), pp.343-367.

Arellano, M., Bond, S., 1991. 'Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations', *Review of Economic Studies*, 58(2):277–297.

Baldwin, R., 1995. 'The effects of trade and foreign direct investment on employment and relative wages', *OECD Economic Studies*, 23:7–53.

Belsley, D., Kuh, E. and Welsch, R., 1980. Regression Diagnostics (New York: Wiley).

Berman, E., Bound, J. and Griliches, Z., 1994. 'Changes in the Demand for Skilled Labor Within US Manufacturing: Evidence From the Annual Survey of Manufacturers', *Quarterly Journal of Economics*, 91():367-397.

Borjas, G., Freeman, R. and Katz, L., 1992. 'On the Labor Market Effects of Immigration and Trade', NBERWorking Paper No. 3761.

Borjas, G., Ramey, V., 1994. 'The relationship between wage inequality and international trade', in: Bergstrand, J. et al. (eds), *The Changing Distribution of Income in an Open US Economy*, North-Holland, Amsterdam.

Borland, J., 1992. 'Wage Inequality in Australia', presented at the NBER Universities Conference on the Labor Market in International Perspective, Cambridge.

Bound, J. and Johnson, G., 1992. 'Changes in the Structure of Wages in the 1980s: An Evaluation of Alternative Explanations', *American Economic Review*, 82():371-392.

Cline, W., 1997. Trade and Income Distribution. Institute for International Economics, Washington, DC.

Courakis, A., Maskus, K.E., Webster, A., 1997. 'Occupational employment and wage changes in the UK: Trade and technology effects', in: Borkakoti, J., Milner, C. (eds), *International Trade and Labour Markets*. Macmillan, London.

Davis, S., 1992. 'Cross-Country Patterns of Change in Relative Wages', in Olivier J. Blanchard and Stanley Fischer (eds), 1992 NBER Macroeconomic Annual (Cambridge: MIT Press), pp.239-292.

Dickens, W. and Lang, K., 1988. 'Why it Matters What We Trade: A Case for Active Policy', in Laura Tyson, William T. Dickens and John Zysman (eds),

The Dynamics of Trade and Employment (Cambridge: Ballinger Publishing), pp. 87-112.

Feenstra, R., Hanson, G., 1996. 'Foreign investment outsourcing and relative wages', *American Economic Review*, 86():252–257.

Freeman, R. and Katz, L., 1991. 'Industrial Wage and Employment Determination in an Open Economy', in John M. Abowd and Richard B. Freeman (eds), *Immigration, Trade, and Labor Markets* (Chicago: NBER), pp. 235-259.

Gregory, M., Greenhalgh, C., 1997. 'International trade, de-industrialisation and labour demand—an input-output study for the UK 1979–1990', in: Borkakoti, J., Milner, C. (eds), 1997*. International Trade and Labour Markets*. Macmillan, London.

Gaston, N. and Trefler, D., 1994a. 'The Role of International Trade and Trade Policy in the Labour Markets of Canada and the United States', *The World Economy*, 17():45-62.

Gaston, N. and Trefler, D., 1994b. 'Protection, Trade, and Wages: Evidence from US Manufacturing Industry', *Industrial and Labor Relations Review*, 47():574-593.

Greenaway, D., Hine, R. and Wright, P., 1999. 'An empirical assessment of the impact of trade on employment in the United kingdom', *European Journal of Political Economy*, 15():485-500.

Grossman, G., 1987. 'The Employment and Wage Effects of Import Competition in the United States', *Journal of International Economic Integration*, 2():1-23.

Gunderson, M., 1992. 'Wage and Employment Impacts Related to the North American Free Trade Agreement', Working Paper, Fraser Institute, Vancouver, Canada.

Hine, R. and Wright, P., 1998. 'Trade with los-wage economies, employment and productivity in UK manufacturing', *The Economic Journal*, 108(450):1500-1510.

Hsiao, C., 1986. Analysis of Panel Data (New York: Cambridge University Press).

Industry Commission, 1995a. Australian Manufacturing Industry and International Trade Data 1968-69 to 1992-93, Information Paper, February (Canberra: AGPS).

Industry Commission, 1995b. Assistance to Agricultural and Manufacturing Industries, Information Paper, March (Canberra: AGPS).

Katz, L. and Summers, L., 1989. 'Can Inter-Industry Wage Differentials Justify Strategic Trade Policy?' in Robert C. Feenstra (ed.), *Trade Policies for International Competitiveness* (Chicago: University of Chicago Press), pp. 85-116.

Konings, J., Vandenbussche, H., 1995. 'The effect of foreign competition on UK employment and wages: evidence from firm-level panel data', *Weltwirtschaftliches Archiv*, 131():655–671.

Krueger, A. and Summers, L., 1988. 'Efficiency Wages and the Inter-Industry Wage Structure', *Econometrica*, 56():259-293.

Krugman, P., 1995. 'Growing world trade: Causes and consequences', *Brookings Papers on Economic Activity*, 1:327–377.

Lawrence, R., 1996. *Single World, Divided Nations*. OECD, Paris.

Leamer, E.E., 1994. 'Trade, wages and revolving door ideas', Working Paper No. 4716. National Bureau of Economic Research, Cambridge, MA.

Martin, J.P., Evans, J.M., 1981. 'Notes on measuring the employment displacement effects of trade by the accounting procedure', *Oxford Economic Papers*, 33():154–164.

Messerlin, P.A., 1995. 'The impact of trade and capital movements on labour: Evidence of the French case', *OECD Economic Studies*, 24:89–124.

Murphy, K. and Welch, F., 1992. 'The Structure of Wages', *Quarterly Journal of Economics*, 107():285-326.

Neven, D., Wyplosz, 1996. 'Relative prices, trade and restructuring in European Industry', Discussion Paper No. 1451, CEPR, London, August.

Nickell, S., 1986. 'Dynamic models of labour demand', in: Ashenfelter, O. and Layard, R. (eds), *Handbook of Labour Economics*, Vol. 1. North-Holland, Amsterdam.

OECD, 1992. Structural Change and Industrial Performance: A Seven Country Growth Decomposition Study. OECD, Paris.

OECD, 1993. Employment Outlook (Paris: OECD).

Phipps, A. and Sheen, J., 1995. 'Macroeconomic Policy and Employment Growth in Australia', *Australian Economic Review*, 109():86-104.

Revenga, A., 1992. 'Exporting Jobs? The Impact of Import Competition on Employment and Wages in US Manufacturing', *Quarterly Journal of Economics*, 107():255-284.

Rodrik, D., 1997. Has Globalization Gone too Far? Institute for International Economics, Washington, DC.

Sapir, A., Schumacher, D., 1985. 'The employment impact of shifts in the composition of commodity and services trade', in: *Employment Growth and Structural Change*. OECD, Paris.

Slaughter, M., 1999. 'Globalisation and Wages: A Tale of Two Perspectives', *The World Economy*, 22(5):609-629.

Wood, A., 1994. *North-South Trade, Employment and Inequality: Changing Fortunes in a Skill-Driven World* (Oxford: Clarendon Press).