The Servitisation of the Australian Manufacturing Sector

And Implications for

Employment, Output and Policy.

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By

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STATEMENT OF AUTHORSHIP

The thesis named above has been submitted for the degree of Bachelor of Commerce (Honours) Economics

I, the undersigned, hereby declare that:

- I am the sole author of this thesis
- I have fully acknowledged and referenced the ideas and work of others, whether published or unpublished, in my thesis
- I have prepared my thesis specifically for the degree of Bachelor of Commerce (Honours) Economics, while under supervision at the University of Newcastle

My thesis does not contain work extracted from a thesis, dissertation or research paper previously presented for another degree or diploma at this or any other university without being referenced accordingly.

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I hereby declare that:

My thesis is approximately 15,000 words in length (exclusive of scholarly apparatus such as tables, graphs, references and appendices).

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Abstract

Servitisation of the manufacturing sector has been an ongoing phenomenon within Australia which has only increased in intensity. We conduct an analysis across the period 1992 to 2012 via the use of input-output tables to determine linkages between sectors and determine service intensity coefficients by use of supply tables and service income reported for Australia. As a secondary approach to linkages we also conduct a 'shutdown' method to determine overall losses of a hypothetical shutdown. We find that although servitisation has been increasing, the linkages formed are still dwarfed dollar for dollar by other sectors, specifically, services, trade and construction. We find that the linkages do, however, mitigate employment losses from the manufacturing sector itself by providing jobs elsewhere in the economy and overall output has grown with emphasis on the service sector due to the manufacturing sector's linkages. Our country comparison analysis with Sweden, the United States and Germany depict how far behind Australia is with other developed nations as these nations not only have higher service intensity coefficients, but, their manufacturing sectors via linkages to other sectors are comparable to their service sectors. The implications derived from our analysis deem that although the manufacturing sector is still a key part of the Australian economy with growing overall output and employment gains, the dollar for dollar expenditure gains are about one third of that of the service sector. Hence in the sectors present state and current trajectory the sector will not provide the greatest benefits in output and employment gains.

Table of Contents

List of Tables and Graphs

Chapter 1

Introduction

Developed nations across the globe are questioning how they can compete in today's global economy and this is no different in the case for Australia. Current data suggests that Australian manufacturing firms would need to cut prices by 38%, 48% and 49% for small, medium and large firms respectively to simply compete (Australian Industry Group, 2006). As such, manufacturing industries within Australia and across developed nations are slowly priced out of the market due to rising input costs relative to that of developing and emerging nations, hence, the future of the industry has become questionable at best. Some commenters say we should go the way of Margaret Thatcher and devote our attention to services rather than compete in areas where we are not as efficient in global terms. The other side of the coin tells a different yet complement story, in that manufacturing firms need to climb the value chain, innovating and creating more sophisticated products where low cost nations cannot compete (Department of Business and Innovation, 2011). Perhaps a mixture of both philosophies could be the answer. None the less, for Australia at least, the current strategy for manufacturing firms is offshoring to cut costs and remain competitive (Australian Industry Group, 2006). This downward trend can be seen in all OECD countries with France dropping 10 percentage points to less than 20% of value added from 1970 to 2007 (Crozet and Milet, 2014) with Sweden dipping from 36.3% to 32% in 1997 and 2006 respectively (Lodefalk, 2010). Servitisation could be the answer to restoring a competitive advantage and to reindustrialize developed countries further diversifying a respected economy. Within this paper, we define servitisation as the use in production or sale of services by the manufacturing firm as either standalone products or embedded within the goods that they sell. Servitisation within the Australian manufacturing sector is an important driver for output and employment growth as it takes a more important role over traditional manufacturing because of significantly higher indirect links that induces these economic effects. As of writing this paper, we still do not have an in-depth study of Australia in relation to how far along the nation is along this servitisation route, if at all. Nor do we have any certain idea of the effects of servitisation on other sectors of the economy in relation to employment and output. As such we expect three main outcomes for the

Australian economy. Firstly, the servitisation of the Australia manufacturing sector will increase over the period 1992 to 2012 in terms of output and employment and hence become a more important role within the economy even though the industry itself is decreasing at the superficial level. Secondly, Australia will not be a leading nation at the forefront of servitisation. Thirdly, the manufacturing sector within Australia will become an increasing important sector for the service industry. The results would be indicative of effective policy options in regards to targeting resources to areas of the economy with the highest gains.

We are seeing a mass offshoring of manufacturing firms and if this is inevitable and we are in a period of mass exodus of the manufacturing industry, then the future of the industry in Australia and indeed for developed nations globally is bleak at best. Current indicators support this assumption with Australian manufacturing employing as little as 12.7% in the first quarter of 2015 (Australian Bureau of Statistics, 2015). Aggregate statistics like employment and output for an industry does not however give the true indication of a sector. The reason is due to the phenomenon that is servitisation and hence, the borders between the once more isolated areas of goods and services have become blurred, as it has been doing so for years. The most notable firm to first utilize a bundle of goods and services would be Rolls-Royce which implemented a “power by the hour” scheme. They initially would sell the engine (the good) but then retain the responsibility for risk and maintenance (the service) to obtain reoccurring revenue that would otherwise have been attained by other firms high up in the value added chain. Similarly, companies such as Shell and BP that originally manufactured oil, now have moved up the value added chain to selling fuel in the retail sector. The trend here, is that the manufacturing sector is required to revitalize itself to not only compete but to survive which is vital for any economy to stay diversified.

This paper will outline existing literature in Chapter 2 which only briefly touches on the links between servitisation and employment, furthermore, the literature is very thin in relation to Australia, which leaves the country in the dark on where it stands on this ongoing phenomenon. We continue in defining our methods of analysis in Chapter 3, which heavily utilises the use of input output tables to derive linkages between eight major sectors using methods derived from Gui and Planting (2000), Mattas and Shrestha (1991) and Valadhkahni (2003). These methods are predominantly, a modified “shut down” approach

to determine aggregate linkages and derived multiplier and elasticity coefficients to determine both forward and backward linkages between sectors. Supply tables are also utilised to determine outputs of the manufacturing sector. We also present time series data on research and development and skill of labour to make a judgement on if existing literature theory is present within Australia. Chapter 4 contains our results and a brief analysis. Herein we conduct a comparison analysis by comparing Australia data derived to three other nations; Germany, Sweden and the United States. Chapter 5 presents a discussion which brings in all previous analysis and relates it to Australia and will conclude with policy implication and responses. Chapter 6 provides some concluding remarks.

Chapter 2

Literature review

The manufacturing sector has been going through structural change in how they conduct business and in particular it's compositional change of service and manufacturing workers and the growing proportion of service to goods income. Furthermore, the number of studies conducted in regards to the perspective of servitisation in mind has also been increasing, however, existing literature utilizes a variety of different techniques and is often only conducted on a small group of dominate nations. Arguably the first links to the notion of servitisation was by Levitt (1972) who stated, "Everybody is in service" (Levitt, 1972, p. 1). Although the paper is only theoretical in nature, it hits the nail on the head in regards to manufacturing firms not being isolated from the rest of the economy and utilizing services. Vandermerwe and Rada (1988) first introduced the first direct links to servitisation arguing that manufacturing industries should servitise for several reasons. Firstly, to create barriers to entry by diversifying its goods and product packages, secondly to obtain loyal customers for repeat sales and lastly, to simply differentiate itself from its competitors. Goedkoop et al. (1999) instigated that the role of servitisation could not only be strategic and economical, but also environmental as services create less of an environmental footprint than the production of goods, in other words, the consumer and the producer can obtain the same value and utilisation with a product and service mix, rather than relying purely on the good itself with the added benefit of lower relative environmental impact. Going one step further would mean an almost pure service business model, for example, renting a washing machine and paying a fixed price per washing cycle. The idea being that the consumer would want to minimise washing to spend less and the producer would produce less washing machines in aggregate, hence resulting in a lower net environmental impact (Goedkoop et al. 1999).

The previous papers looked at the theoretical side of servitisation, however, without empirical evidence one cannot confirm nor deny the effects of the servitisation phenomenon. As stated previously, each paper utilizes an assortment of different techniques and methods. Crozet and Milet (2014) determine service intensity by determining service income as a percentage of total income. This method of analysis looks

purely at the output side of the equation and misses key data from the input side of the equation. Conversely, studies from Kommerskollegium (2012) and Dachs et al (2012) have focused on the input side by using input-output analysis to determine the level of service inputs into manufacturing firms. Again, although this provides informative information, the paper looks at one side of the story. Differently, Neely (2009) determines the level of servitisation from the business description of each firm to determine if its pure manufacturing, pure service or a hybrid of both. This method could give skewed results to the level or composition of services offered. Firstly, although Neely includes multiple nations as a comparison to the core nation, Germany, he only includes medium and large firms (>100 = n) which does not give a true representation of an entire economy and misses possible patterns such as the apparent u-shape curve in regards to servitisation and firm size (Dachs et al, 2012; Neely 2013). Secondly, even though a business description should give an accurate idea of the operations of a business, it is not absolute in terms of all of a firm's functions and does not determine the service intensity within said firm.

Due to the availability of data, studies on servitisation are conducted on the highest aggregate level with the utilization of one of the techniques outlined above with emphasis on determining total servitisation levels. Less attention is given to disaggregated variables within the economy and the relationship between certain aspects of a particular or group of economies. There are exceptions that focus on particular areas of an economy such as trade, reasons behind servitisation and costs and benefits. Dachs et al (2012) in particular conducts a study based on disaggregated variables with a selection of over a dozen nations with a few notable findings. Firstly the results demonstrate a weak relationship between R & D and the service content of manufacturing, once thought to be a high driver for servitisation (Ahamed et al, 2013; Lin and Lin 2012). However a disaggregation of manufacturing industries supports previous thought as Dachs et al (2012) finds certain manufacturing industries have a stronger positive relationship between innovation and servitisation when disaggregated into level of innovation intensity categories and a statistical cluster analysis is performed. Secondly, manufacturing firms in majority of the nations utilized within the study provide vastly more knowledge intensive services such as computer services rather than other low knowledge intensive services such as installation with notable exceptions being the Netherlands, Lithuania and Greece (Dachs et al, 2012).

Lastly, on the sector level, firms with the highest offering of number of services, regardless of the intensity of each, produced the highest service turnover. However no results were given to determine if they were the most profitable over the pure manufacturing or low service intensity industries which is suggested to show a negative relationship between service offerings and total gross profit (Dachs et al, 2012; Neely, 2009).

Cross-country analysis in regards to servitisation coupled with both input and output sides to the equation has been a rather thin area of study. This is on account of difficulties in obtaining data that is both comparable and available for the same given time periods. None the less, Pilat and Wolfl (2005) make use of both input output tables and a servitisation variable derived from the ratio between service supply and total supply via supply tables. Notably, the paper uses a time series to obtain value added of services within the manufacturing sector from early 1970s to the mid 1990s for 10 OECD nations, including Australia which depicts growth from 14% to 23%, on par with France and Germany and only surpassed by Japan and the United States. Pilat and Wolfl (2005) demonstrate a change in total output resulting from an increase of 10% in demand for manufacturing goods which puts services at about 0.4% in 1997. The output perspective demonstrates a similar story with an increase of total service income as a percentage of total income from 1998-2002 almost doubling from 7.9% to 15.4% in Nordic nations but staying constant at a mere 0.9% in Japan. The last notable area that is rather unique to the literature is that on average, 40% of those employed in the manufacturing sector are in fact involved in service type oriented activities (Pilat and Wolfl, 2005). The first limitation to the paper is its currency, however, the paper can still give a comprehensive insight into the phenomenon of servitisation which has been assumed to have increased substantially. The second limitation is that the paper only gives results for Australia in selected areas such as service value added in the manufacturing sector and mixed results for included countries in other areas, as such, one cannot assume or generalise based on the results for Australia specifically as it can fall anywhere within the spectrum of the given results.

Trade and in particular service trade has seen the spot light in recent years. One reason for this is because of its increasing relevance to modern day developed economies. This phenomenon makes service trade, if it can be capitalized, a potential source of economic welfare gains. These gains might be dampened by current trade policies as goods and

services are often differentiated in a world where bundles of goods and services are rapidly becoming dominate (Komerskollegium, 2012). Links between servitisation and trade, in particular, export, in conjunction with its issues and benefits is present within a vast amount of literature, predominantly in Crozet et al (2014), Boddin and Henze (2014), Dimache and Roche (2012), Kelle (2012), Lodefalk (2010), Lodefalk (2012), Lodefalk (2015), Neely (2013) and Padadilla and Wirjo (2014). Originally, globalisation lead to an increase in exports of goods produced, however, the composition of total trade has given way to an increase in service exports (Pasadilla and Wirjo, 2014). Methods were developed to determine the level of total services exported which also included embedded services in products and the effect of the phenomenon of servitisation of exports (Cernat and Kutlina-Dimitrova, 2014). The "Mode 5" method of analysis which gives a more precise level of services exported by manufacturing firms is only possible due to changes in global and country databases that separate each variable rather than aggregation. This method, however, is not true to determine domestic servitisation levels to date, which gives way to the number of different uncomparable aggregate servitisation levels. Domestic service intensity, when derived, within the manufacturing industry has also been shown to improve export intensity with emphasis placed on in-house services rather than outsourced services. Lodefalk (2015) a leader in servitisation research, writes extensively on the links between services, goods and trade and finds that manufacturing industries are not declining in developed nations as many have thought, and that they are, in some cases, leaders of service export which he finds notably for Sweden and confirmed in subsequent studies done for Germany and France (Boddin and Henze, 2014, Crozet and Milet 2014, Kelle 2013). These nations, however, are considered large manufacturing nation than Australia. Furthermore, in terms of value added, manufacturing firms export a significant proportion of services relative to goods with developed nations at 28.5% and Australia specifically at 32% of manufacturing trade. These studies emphasis the growing trend of services embedded in goods primary for trade purposes but can also be related to the growing trend in domestic sales of goods and services.

We stated previously that research based on servitisation is a relatively new phenomenon and has only recently started to gain attention from other academics on a larger scale. As such, methods from other disciplines other than economics have emerged, notably from

technology based backgrounds. Although the idea of servitisation goes by the name Product Service System (PSS), the intent behind the term is essentially identical, just viewed from a different perspective and end use (Dimache and Roche, 2013). These studies use a spectrum from mass production to mass services and are often used as tools to move from a pure manufacturing firm to a servitised firm. Research that has taken this and similar approaches have moved from understanding the effects of price and quantity characteristics to examining relationships and revealing costs and benefits such as increased customer relationships to induce future sales, service income being less volatile than goods income in economic crises and not obtaining the right skills prior to pushing for a servitised firm leading to business failures (Dimache and Roche, 2013). Visnjic and Van Looy (2011) find that servitisation can also bring value to firms, customers and society as a whole if the transition is well managed. However, this study was done with a small study sample and may not be a true representation across several industries or countries outside of the sample. Studies at the micro level focus on one or a small group of large firms that have already undergone some level of servitisation to determine why they underwent business structural change, how they did it, and the problems associated with the change with results consistent with ideas mentioned below. (Ahamed et al, 2013; Lee and Tsai, 2014).

The reasons for servitisation vary but ultimately fit under four main categories, regardless of the nation in question, them being strategic, economic, technological or environmental. (Neely, 2013). These ideas can be linked back to ideas such as Porter's 5 force, competitive advantage theory and transaction cost economics (Wikhamn and Knights, 2011). Furthermore, the benefits and costs of servitisation are well documented (Ahamed et al, 2013; Vandermerwe and Rada, 1988) and the entire process could be seen as a new technique to provide these benefits which can be seen in any business or economics textbook such as setting up barriers to competitors, third-parties or customers, creating dependencies and loyal customer bases, differentiation of market offerings, diversification of income which mitigates risk, new innovations that have not entered to market previously and to enhance R & D and market research initiatives.

The composition of skills within the manufacturing sector has altered, favouring higher skilled labour over the traditional lower skilled labour with firms hiring more mathematicians, computer professionals, business professionals and engineers (Lodefalk,

2012). This is supported with the composition of in-house services increasing by 10% having a 10% higher human capital intensity indicating higher skilled labour (Lodefalk, 2012). In house services have also seen an increase with emphasis on research and development and knowledge intangible assets with transport and telecommunications a close second (Lodefalk, 2012). Lodefalk (2012) states that servitisation increases export intensity with in-house services brining the largest increases for all industries with a mean 10 per cent higher proportion of services in in-house production associated with a 0.6 per cent higher export intensity (takes non-linearity and interactions into account). These values, however, are only derived for the Swedish economy and are not compared to global peers, which could indicate that the effect is greater or lesser in intensity on a global scale. This increase is theoretically assumed to be conducted by deciding to export and hence to do so profitably, productivity needs to be ramped up. Servitisation allows for higher productivity through higher skilled worker channels and lowering input requirements (Lodefalk, 2012).

Firm size in relation to servitisation is mainly studied in larger firms exceeding 100 employees in majority of the current literature discussed above. As such, studies either assume servitisation is occurring across the board or occurring for very large firms disproportionately to the smaller firms depending on the data set and methodology used. This coupled with the knowledge of positive impacts of servitisation on exports may lead to a conclusion that larger firms have a competitive advantage relative to smaller firms all things equal. There are a few exceptions to this, Dachs et al (2014) use a large scale database with firms considered as little at 25 employees which brings new insight to the literature demonstrating a U-shaped curve inducing that not only large firms exhibit servitisation tendencies but also smaller firms, with the medium firms being the exception. Interestingly, the paper demonstrates that firm size is more of an indicator of servitisation over national differences which play only a minor role which is in contrast to other existing literature (Neely, 2013). An interesting fact here to note, is that the U shape curve seen with servitisation compared to firm size is also the same U shape demonstrated with innovation and firm size. This coincides with existing literature that states that servitisation is a form of innovation and value added technique, however, it has not empirically been proven in the servitisation context. (Kommerskollegium, 2013).

This paper attempts to fill gaps in the literature in relation to Australia, its servitisation intensity rate and the effects servitisation has had on the manufacturing sector and the wider economy in regards to employment and output across a 20 year period from 1992 to 2012.

Chapter 3

Methodology

The input and to an extent the output components of this paper heavily utilizes input-output tables, as such, before presenting the theoretical framework, it would be optimal to provide the structure, concept and application of input output analysis, as such, refer to Appendix A for this discussion if required.

To conduct input-output analysis, we need to derive first the direct requirement coefficient matrix and the subsequent total requirements coefficient matrix.

The direct requirements coefficient matrix is compiled as follows

$A = \{a_{aj}\} = X_{ij} / X_j$

Where X_{ij} is industry j's direct input from industry i, and X_j is total output of industry j.

The total requirements matrix can then be compiled which is also called the Leontief inverse matrix and is compiled as follows

$B = \{b_{ij}\} = [I - A]^{-1}$ which we will define as $b_{\bullet j} = \sum b_{ij}$

Which is the sum of rows for column j from the total requirements matrix and where I is the inverse matrix (diagonals equal to 1 with the remainder of the matrix equal to 0).

As $b_{\bullet j}$ measures the aggregated output from all industries generated from one unit final demand of product j, we call it the backward linkage of industry j. Forward linkages are defined as $b_{\bullet i} = \sum b_{ji}$ which is the sum of columns for row i from the total requirements matrix

We will be using employment multipliers to determine direct and indirect effects between industries, with emphasis on the indirect effects of the service industry caused by the manufacturing industry. The employment multiplier can be interpreted as the impact on aggregate employment if the final demand in sector J increase by a determined level of output, herein, $1 Million. We define it as follows (Valadkhani, 2003):

$$E_j^m = \sum_{i=1}^{n} (l_i / x_i)\, b_{ij}$$

Where l_i and x_i denote the employment and output respectively. b_{ij} is the Leontief inverse Matrix (denoted as B above) and n is the number of sectors.

We can determine individual sectors requirements for a given output by simply multiplying the employment coefficient (derived by l_i / x_i) by the corresponding variables in the Leontief inverse matrix b_{ij}. As the total multipliers are not absolute and as such change from one dataset to the next, to make comparison between the sets we determine a percentage for each individual sector based on that sector's total multiplier.

Calculating multipliers and linkages by this method does not take into account the actual size of the industry, nor does it assist in determining its expansion capacity. Multipliers that express high backward linkages could indicate that large sectors as insignificant or small industries as being important that is, if we increase large sectors by 1% it could have a larger aggregate result than determined by simply viewing the multiplier and similarly, we could increase small sectors with high multipliers by 100% and in aggregate terms they would only increase by a minimal amount. We can identify high employment generating industries by utilizing employment elasticity for individual sectors (Mattas and Shrestha, 1992). Employment elasticity for any sector measures the percentage change in aggregate employment in the economy as a result of a one percent change in final demand for an individual sector. Similarly, we can determine the percentage change in individual sectors given the one percentage change in final demand, which will assist backwards linkage analysis, particular between the service and manufacturing industry simply by not aggregating the results.

$$E_j^e = \frac{\partial L}{\partial f_j} \cdot \frac{f_j}{L}$$

Where L is the total employment in the economy, f_j is the final demand in sector i, and

$\frac{\partial L}{\partial f_j}$ is the employment multiplier.

Mattas and Shrestha (1991) also derive a means of using elasticity to determine high output sectors. The output elasticity used presents the percentage change in the output of sector i due to a percentage change in final demand of that particular sector. This can also then be aggregated to determine total output, however, for our purposes we prefer disaggregated elasticity.

$$\mathbf{DOE}_{xjyj} = b_{jj}(y_j/x_j)$$

Where:

b_{jj} is the column vector of sector j

y_j is the final output of sector j; and

x_j is the gross output of sector j

Up to this point, we have only discussed the input side of the manufacturing sector. We can utilize both forward linkages as outlined previously from the manufacturing sector to all 8 sectors of the economy and compare these to the backward linkages that are derived. Furthermore, we can utilize a servitisation intensity variable to determine output of services from the manufacturing industry. Hence, we derive service income as a percentage of total income received by the manufacturing sector. It should be noted that in regards to Australia, service income is not explicitly given but must be derived firstly from the Australian Year Book category 1301.0. The year book displays goods export income as a percentage of total income as well as the total export income amount and as an aggregated amount for the manufacturing sector, hence, we simply divide the export amount by the percentage then multiply this value by one hundred. This derives total goods income which we then subtract from goods and service income to arrive at service income for each dataset. Although our service intensity variable is an acceptable proxy and indication of servitisation year on year, it is difficult to compare this data with other economies as service income for the manufacturing sector is rarely reported and is often aggregated with total income or at the lower disaggregated level of goods and service income. However, we can make use of supply tables which are usually not compiled on a yearly basis but are created for most OECD economies to determine the output of service components from the manufacturing sector.

By utilizing supply tables, we can capture the service output of the manufacturing sector by deriving service output as a proportion of total output.

Where an economy is made up of N sectors j with j = 1,2,3,4,…,n, t_j is the total output of sector and s_j is the service output component. si_j is the service intensity of sector j, with SI being the total service intensity of the economy, hence:

$si_j = s_j / t_j$

And the manufacturing service output total component being:

$SI = \sum s_j / t_j$

We then compare the difference in total service intensity (SI) of each economy. We calculate the service intensity coefficient firstly without retail and wholesale trade and secondly we add retail and whole trade to our coefficient. This is conducted as retail and wholesale trade is a significant percentage of total services utilized, however, they are not necessary classified as direct services.

One can easily see the direct importance of an industry in regards to output and employment by the respected output levels and number of people employed in the sector. What we cannot clearly see is the indirect importance of any given sector as one sector does not sit in isolation due to forward and backward linkages, that is, if a sector is stimulated, then there would be either flow on or flow back effects that ripple out into the broader economy creating output and employment due to a number of multiplier effects. If we look at a sector that has minimal amount of backward linkages and hence its output is mainly exported overseas with little to no domestic intermediate uses (or there is a low amount of output to start with) then there would be very little indirect effects causing employment and output. Hence, by definition, the total effect would be close to the easily observable direct effect. The other side of the coin is that if a sector is well integrated into the wider economy with a large amount of linkages, then the indirect effect can be much greater than the direct effect, hence, this hidden employment and output can be unobservable without proper analysis. If we assume that all the output for this industry is substituted with whatever amount that it would normally produce, the on flow effects from the initial production would still be greater than its own initial effect. We can use multipliers as

previously discussed which we can use to estimate small changes, or, we can use a “shut down” method utilised by Valadhkani (2003) which is modified from the original to mitigate leakages via importing sector i’s output. The model determines the indirect extent of the loss in output and employment if a given sector was hypothetically shut down and does this by aggregating the output loss in all sectors. We measure the aggregate loss as follows:

$$S_1^Q = \overbrace{\overline{x_1}}^{\text{direct effect}} + \overbrace{\sum_{i=2}^{n} \Delta x_i}^{\text{indirect effects}}$$

Where S_1^Q is total contribution to output, x_1 is $\overline{x_1}$ the direct effect of the observed output/employment of sector j, and Δx_i is the output loss in sector i.

For reference to the framework of the shutdown method see Appendix B.

Although the focus of this paper is on the utilisation of input output tables and subsequent analysis and we do not create or utilise models by regression analysis or otherwise, from existing literature we can stipulate that research and development intensity and higher skilled labour as a proportion of total labour within the manufacturing sector would either not increase or increase respectively. High skilled labour is defined as level 7 or higher on the Australian Qualifications Framework and is considered at the level of or higher than a degree or equivalent. As these variables have not been analysed in relation to servitisation and Australia conjointly, we create a time series of aggregate expenditure on research and development and expenditure as a percentage of total revenue.

Limitations of IO Analysis

IO analysis has an assortment of uses in regards to environment-economic frameworks, analysis of the composition of exports and foreign value added levels in nation's exports to name a few. However, these are only possible under several key assumptions where can be seen in Appendix C. Although these assumptions are essential to calculate and utilize key multipliers, they also reflect the limitations and shortcomings of the method in itself (Gretton, 2013).

Firstly, multipliers assume that a sector can produce more output without taking away resources from other activities, that is, it is assumed that there is always spare capacity in the economy so that if a sector increased its product the rest of the economy could accommodate with the require intermediate inputs (Gretton, 2013). If the economy is running at full capacity in any area, the multiplier effect will ignore displacement effects, that is, employees would need to move from one industry to another. This means that a potential high multiplier could include hidden opportunity costs, which, if captured correctly, would depict a lower multiplier. The validity of this would be highly dependent on the availability of current resources, such as labour, land and capital, in the economy at any given point of time. One can check the validity of a multiplier by contrasting the multiplier with the capacity utilisation rate and the employment elasticity. We will be computing the employment elasticity for each given sector, however, it is beyond the scope of this paper to compute the sectoral capacity utilisation rate. The assumption that labour is purely transferable is also unrealistic as skills are not transferable across all sectors and people are not necessarily mobile.

Secondly, the assumption of fixed prices is unrealistic, that is, the effects of a price change would play a role in the allocation of scarce resources due to both supply and demand mechanics, predominantly rent seeking behaviour. Furthermore, relative prices would change based on constraints on factors of production and policy changes (such as tariff changes, relaxed or constrictive competition policy or policies that influence business costs and prices) (Gretton, 2013).

Thirdly, a linear production function means that changes in technology and more efficient (or less efficient) use of the inputs have no effect in analysis. In reality, an increase in technology would impact the use of inputs, either by quantity of composition. The mix of outputs would also alter, including the supply of products to final users and both investment and export demands (Gretton, 2013). Furthermore, the linearity within the cyclical economy means that economy, according to the analysis, would respond the same was in a boom as it would in a recession. As an example, let us assume an input output table was compiled in a recessive period such as 1990 or during the recent global financial crisis and we used this table to produce a model for a boom period, such as the mid 2000s. The labour to output ratios would be excessive as firms hold onto workers when they speculate a boom is around the corner (Valadkhani, 2003).

Fourthly, there is a lack of allowances for household purchasers' marginal responses to change, in that real budget shares remain unchanged in respect to household income and relative prices. In reality, household purchases are highly depended on relative income and price changes (Gretton, 2013).

Lastly, there is an absence of budget constraints for the private sector so that private sector consumption occurs without reducing demand from other areas of their consumption. In reality, the private sector is constrained in purchases of goods and services relative to its income (or credit) potential (Gretton, 2013).

Although there are several limitations to IO analysis, Gretton (2013) states that IO analysis provides key information for analysing linkages between activities, which this paper will utilize and hence will not be restricted by these key limitations. Furthermore, as this paper will also focus on employment multipliers and that economies are rarely at full employment (Mitchell, 2013), the employment multiplier's use will only be restricted by "unprepared" employment (unemployment that cannot move into the sector due to a lack of skills or otherwise). Hence, the first limitation outlined above will have a lesser impact than assumed.

It is worth noting that the IO analysis utilized in this paper is not the only technique that could be employed. More recent models such as computable general equilibrium (CGE) and social accounting matrices (SAM) have addressed some of the inherent problems outlined

above. However, CGE specifically is undermined by capital debates questioning the validity of aggregate product functions among other criticisms (McKitrick, 1998). None the less, the methods employed in this paper are indicative of the forces at work. Furthermore, it is argued that the IO methods are utilized to represent “a great simplification of theoretical model but a considerable elaboration and refinement of statistical data, to the point where theory and empirical implementation meet” (Barna, 1961, p.3).

Our use of supply tables to derive service intensity percentage coefficients for Australia, Germany, Sweden and the United States also contains limitations. Firstly, they understate the true output of services from the manufacturing industry as they do not capture all service outputs, which can also and are often embedded in goods or reported by other means. Secondly, they cannot be used to report expected service output due to the reason stated previously and hence, will understate total service output. Given these limitations, they are still useful in determine service output and making cross comparison analysis as this method of determining service intensity can be derived for a wide variety of nations and they can be used to compare a change over time given the method utilized to derive the supply table has not changed substantially over the time period.

Data

In this paper we utilize IO tables 1992, 1996, 2001, 2007 and 2012 obtained from the Australia Bureau of Statistics category 5209.0.55.001 and 5209.0 to capture a twenty year period in approximately five year increments where the IO tables in which direct competing imports exist. As the standards for categorisation varies from dataset to dataset, in both number (35 to 114 aggregated industries) and inclusiveness of each category (one category is disaggregated in one table but included as part of another in a different table) we aggregate the industries into eight sectors to allow for comparison analysis. The classification is based on the ANZSIC 2006 classification scheme which were revised from the ANZSIC 1996 scheme which causes some of the disaggregated issues mitigated by aggregating to eight sectors. The direct allocation of input coefficient tables are presented by the Australian Bureau of Statistics as percentages, as such, for analytical purposes we compute the tables into aggregates out of one to create direct requirements coefficient tables. All calculations are performed using excel whilst utilising matrix functions where applicable.

Service income is derived from the Australia Bureau of Statistics category 8155.0 Australian Industry, 8221.0 Manufacturing Industry and 1301.0 Australian Year Book. Service income is not explicitly given and as such we were required to calculate the value by using the percentage of goods export sales as a proportion of total goods sold which is given. The total goods income is then determined and subtracted from goods and service income which is also given to determine service income.

We obtain research and development data from category 8104.0 Research and Experimental Development ABS and divide the expenditure by total income of the manufacturing sector. This derives a percentage of research and development of total revenue. We also obtain education level from category 6235.0 - Labour Force Status and Educational Attainment ABS and category 6227.0 - Education and Work ABS. We obtain our education coefficient by splitting the data into two groups, highly educated and other, with highly educated being a degree or equivalent and other being any other skill level below the threshold. The highly educated coefficient is then divided by total employment in the industry to determine our education intensity percentage.

Industry to Industry Input-Output tables are obtained for Sweden, Germany and the United States for the reference year 2007 from the World Input Output Database. Supply Tables are obtained from Eurostat for the same countries and the same reference year.

Chapter 4

Empirical Results and Analysis

We discussed previously that backward linkages determine the effect of sector j's expansion on sector i as it utilizes sector i's inputs. Table 1 is the simple employment service multiplier as an input into the manufacturing sector. The percentage of services as a composition of the total eight sectors grows from 1992 to 2007 by a mean value of 3.54% across the period to reach 30.69% of total employment inputs from 20.07%. From 2007 to 2012, however, the composition of services drops by 8% to 22.69%, only 2.62% above 1992. Furthermore, the service portion of the multiplier drops from 3.08 to 1.35. As the simple multiplier for the manufacturing industry is 5.96, we can interpret this as to induce 5.96 units of employment in the economy, the manufacturing sector itself will need to provide 3.32 units with the service sector providing 1.35 units of employment for 2012. For the full employment multiplier table see appendix D

Table 1: Employment Multiplier Manufacturing Sector 1992 to 2012

Employment Multiplier Manufacturing Sector 1992 to 2012					
Services	1992	1996	2001	2007	2012
Multiplier	3.08	3.30	2.77	1.77	1.35
Percentage	20.07%	25.04%	27.42%	30.69%	22.69%
Change		4.97%	2.38%	3.27%	-8.00%

Source: Author's Calculations

The data is indicative of three main explanations, firstly, a normal cyclical period of an economic slump throughout the general economy, particularly in severe downturns, such as the global financial crisis, could have a greater impact on the utilization of service employment inputs than other employment inputs. Secondly, the manufacturing sector has decided to utilize less service employment inputs and thirdly, the manufacturing sector utilizes less service employment inputs but the productivity of these inputs have increased hence manufacturing firms do not require the same amount of service employees. A comparison was conducted between Australia and the United States for 2007 and 2012 to give a clearer indication of which explanation seems most plausible.

Table 2 is the US data for 2007 and 2012. Full employment multiplier tables present in appendix E.

Table 2: US Multiplier Manu Sector 2007 to 2012

US Multiplier Manu Sector 2007 to 2012		
Year	2007	2012
Multiplier	14.37	1.71
Percentage	60.54%	26.26%
Change		-34.29%

Source: Author's Calculations

Australian data is comparable and supported by the United States, however, with the later a more drastic decrease is evident by 34.29 percentage points from 60.54% to 26.26%. This is understandable considering the US economy experienced a relatively larger economic downturn by the global financial crisis compared to Australia which never technically even entered a recession during the period. As outlined above, given the time period, the first explanation is the more likely scenario, that is, service employment inputs are effected more than other inputs into manufacturing, which is understandable as overall production would decrease and firms attempt to cut costs where possible while falling back on their main core competencies. As such we expect the composition of employment service inputs to increase in the future as the economy improves, however, once again, this cannot be confirmed or denied until consecutive input out tables are released. It would be more indicative if input output tables for every year during the global financial crisis were derived, as the direct impact may be higher than depicted here and hence the values for 2012 are actually already an improvement.

Employment is only one area that servitisation can be analysed, another predominate area that is a key indicator of an economy is output, or rather, the output of the services sector as an input to the manufacturing sector. Once again, we do this for Australia across the entire sample period and for the United States for 2007 and 2012 to assist in determining if the global financial crisis is the potential cause of any unexpected results or some other element.

Table 3 and Table 4 are for Australia and the United States respectively. See appendix F and G for Australia and US full output multiplier tables.

Table 3: Output Multiplier Manufacturing Sector 1992 to 2012

Output Multiplier Manufacturing Sector 1992 to 2012					
Services	1992	1996	2001	2007	2012
Multiplier	0.25	0.35	0.36	0.34	0.29
Percentage	12.80%	16.94%	17.67%	16.97%	15.59%
Change		4.14%	0.73%	-0.69%	-1.38%

Source: Author's Calculations

Table 4: US Multiplier Manu Sector 1992 to 2012

US Multiplier Manu Sector 1992 to 2012		
Year	2007	2012
Multiplier	2.36	0.33
Percentage	39.64%	14.08%
Change		-25.57%

Source: Author's Calculations

We can see a similar result with an increase composition of services required for the manufacturing industry as we saw for employment, however, with a slight decline starting in 2001 to 2012 of 2.06 percentage points from 17.67% to 15.59%, still above the lowest point of 12.80% by 2.79%. The changes in the service multiplier from 2001 to 2007 are so minute, that they could be simple fluctuations and are caused by the cyclical nature of the economy at any given point with the change from 2007 to 2012 having been the cause of the global financial crisis. As such, we compare the data to a much larger economy, the United States. As table 4 demonstrates from 2007 to 2012, the service input multiplier for the manufacturing sector decreased from 39.64% to 14.08%, a decline of 25.57 percentage points. Once again, a larger percentage drop relative to Australia can be explained by the United States entering a longer term recession.

Multipliers can overstate or understate the importance of an industry, as such, we utilized employment elasticity values and disaggregated them into sectors so that we can determine where employment and output is generated given a percentage increase in j sector final demand. As we are interested in the relationship between manufacturing and services, table 5 demonstrates these key data points (See appendix H for full employment elasticity table

for Australia). To compare over a time period, we calculate the percentage of the elasticity compared to total elasticity. We notice that even though the elasticity value decreases from 2001 to 2012 from 0.1029 to 0.0893, the total elasticity of employment for services actually increases by a total of 0.0103 from 1992 to 2012. Even though total elasticity values have been decreasing from 2001, the increase of the service component defined by the composition percentage hints at the growing importance of service employment within the manufacturing industry. In terms of ranking, table 6 depicts the manufacturing sector's employment elasticity with its corresponding ranking across the study period. Services are ranked second in 1992 and then proceed to rank first across the rest of the period. These values tell us that if there is a 10% increase in final demand in the manufacturing sector, we would expect to see a 0.09% increase in service employment for 2012. The consistent decrease in the manufacturing sector and increase in the service sector depicts the growing importance of the service sector for the manufacturing sector in terms of employment.

Table 5: Employment Elasticity Manufacturing Sector 1992 to 2012

Employment Elasticity Manufacturing Sector 1992 to 2012					
Services	1992	1996	2001	2007	2012
Elasticity	0.0790	0.1002	0.1029	0.0959	0.0893
Percentage	42.33%	49.78%	53.26%	61.06%	58.69%
Change		7.46%	3.48%	7.80%	-2.38%

Source: Author's Calculations

Table 6: Employment Elasticity Ranking Manufacturing Sector 1992 to 2012

Employment Elasticity Ranking Manufacturing Sector 1992 to 2012					
	1992	1996	2001	2007	2012
Agriculture	0.002 (4)	0.0022 (4)	0.0019 (4)	0.0011 (5)	0.0012 (5)
Mining	0.0005 (5)	0.0005 (5)	0.0002 (6)	0.0003 (6)	0.001 (8)
Manufacturing	0.0943 (1)	0.0857 (2)	0.0743 (2)	0.0436 (2)	0.0499 (2)
Construction	0.0002 (6)	0.0002 (6)	0.0012 (5)	0.0014 (4)	0.0016 (4)
Trade and Transport	0.0103 (3)	0.0121 (3)	0.0124 (3)	0.0144 (3)	0.0086 (3)
Services	0.079 (2)	0.1002 (1)	0.1029 (1)	0.0959 (1)	0.0893 (1)
Public Admin. Defence	0.0002 (7)	0.0001 (8)	0.0002 (7)	0.0002 (7)	0.0002 (6)
Utility	0.0001 (8)	0.0002 (7)	0.0001 (8)	0.0001 (8)	0.0002 (7)
Total Multiplier	0.1866	0.2012	0.1932	0.157	0.1521

Source: Author's Calculations

Output elasticity as an input for the manufacturing sectors in regard to services can be seen in Table 7 (See appendix I for full table). We can see that our elasticity coefficient increased only slightly overall from 1992 to 2012 by 0.0051, however there is a consistent composition increase in regards to services as a percentage of the total elasticity ending with an overall increase of 18.16 percentage points. The greatest increase occurred from 1992 to 1996 and again from 2007 to 2012. This could indicate that service output is less sensitive than manufacturing output in period of economic turmoil. Either way, the growing elasticity in regards to services induced by manufacturing demonstrate its importance and growing backwards linkages, with emphasis on backward linkages to the service sector. We interpret the elasticity as percentages, hence, if there was a 10% increase in final demand of the manufacturing sector in 2012 we would expect there to be a 0.5% increase in output derived from services.

Table 8 gives us a snap shot of each year present into the study and of the importance of outputs for each sector utilised by the manufacturing with its corresponding ranking. As stipulated from the composition of the manufacturing and service sectors above, the other six sectors contribute very little in terms of output used as inputs for the manufacturing sector. with a growing importance in the service sector and decreasing importance in the manufacturing sector with the service sector becoming the most important area for the manufacturing sector in 2012.

Table 7: Output Elasticity Service component 1992 to 2012

Output Elasticity Service component 1992 to 2012					
Services	1992	1996	2001	2007	2012
Elasticity	0.0469	0.0587	0.0511	0.0529	0.0520
Percentage	28.66%	36.48%	37.88%	40.46%	46.82%
Change		7.83%	1.40%	2.58%	6.36%

Source: Author's Calculations

Table 8: Output Elasticity Ranking Manufacturing Sector 1992 to 2012

Output Elasticity Ranking Manufacturing Sector 1992 to 2012					
	1992	1996	2001	2007	2012
Agriculture	0.0009 (5)	0.001 (8)	0.0007 (4)	0.0006 (6)	0.0008 (6)
Mining	0.0013 (4)	0.0013 (4)	0.0006 (6)	0.0012 (4)	0.0023 (4)
Manufacturing	0.1109 (1)	0.0943 (1)	0.0753 (1)	0.0691 (1)	0.0501 (2)
Construction	0.0001 (8)	0.0001 (7)	0.0009 (5)	0.0012 (5)	0.0018 (5)
Trade and Transport	0.0041 (3)	0.0052 (3)	0.006 (3)	0.0055 (3)	0.0036 (3)
Services	0.0469 (2)	0.0587 (2)	0.0511 (2)	0.0529 (2)	0.052 (1)
Public Admin. Defence	0.0002 (6)	0.0001 (6)	0.0001 (8)	0.0002 (8)	0.0002 (8)
Utility	0.0002 (7)	0.0002 (5)	0.0002 (7)	0.0002 (7)	0.0003 (7)
Total Multiplier	0.1646	0.1609	0.1348	0.1308	0.1111

Source: Author's Calculations

Up to this point, we have mainly focused our analysis on backward linkages from the manufacturing sector to the entire economy, disaggregated into eight sectors. We can also conduct an analysis of forward linkages from the service sector to all eight sectors of the economy and track these across our study period. This will enable us determine the composition of services given to manufacturing relative to every other sector and how this changes.

Table 9 depicts the percentage composition of each out of the total forward linkage for the service sector for a given year. Overall, forward linkages from the service sector to the entire economy change very little from 1992 to 2012. The manufacturing sector only increase by 0.02 percentage points from 1992 to 2007 in aggregate before dropping by 0.25 percentage points.

In fact, from 1992 to 2012, the forward linkage to the manufacturing sector actually change the least compared to every other sector in the economy and has the third lowest linkages with only slightly higher linkages than Agriculture and the Utility sector for 2012. The linkages to the manufacturing sector in terms of ranking change from year to year, with the largest change occurring with the largest composition change from 1992 to 1996, however, this is reverted from 1996 to 2001.

Table 9: Forward Linkages of the Service Sector to the Economy - Composition 1992 to 2012

Forward Linkages of the Service Sector to the Economy - Composition 1992 to 2012					
Year	1992	1996	2001	2007	2012
Agriculture	7.55%	7.48%	5.19%	7.69%	6.60%
Mining	7.13%	7.30%	7.51%	6.47%	8.84%
Manufacturing	8.12%	9.62%	8.23%	8.41%	7.89%
Construction	8.39%	8.45%	10.27%	12.87%	10.51%
Trade and Transport	11.10%	15.09%	20.06%	12.58%	11.76%
Services	41.13%	35.49%	32.14%	36.05%	37.89%
Public Admin. Defence	11.93%	9.78%	8.26%	9.67%	9.05%
Utility	4.66%	6.80%	8.34%	6.26%	7.46%

Source: Author's Calculations

Higher forward linkages than backwards linkages means that a particular industry is more sensitive to the output of other industries, in other words, increased output or employment within sector i would have less impact on sector j. This has implications for policy in utilizing finite resources, and although we cannot track the extent of servitisation by these forward linkages, they can determine the changes in importance of the manufacturing sector across the time period as higher backward linkages would have higher multiplier effects through an economy than higher forward linkages. Table 10 and table 11 below represents both forward and backward linkages with their percentage of the total multiplier for the given multiplier retrieved from the Leontief inverse table and calculated elasticity in regards to both output and employment respectively. In reference to output, there is only a slight increase in backward linkages relative to forward linkages which is mostly brought about by a decrease in overall forward linkages with an almost even split of 52% and 48% for forward and backward linkages respectively. However, the elasticity coefficients, which determine the importance level depicts a slightly different story with a higher backwards linkage coefficient of 58% relative to 42% of forward linkages. We see a similar trend for employment with near equal composition percentages for the multiplier, but much higher backward linkage percentages for elasticity.

To see if there is an impact due to the global financial crisis, we compare 2007 to 2012 for Australia and the United States. We find for Australia, that even though the multiplier and elasticity coefficients for both output and employment decreased, the composition grew in favour of backward linkages opposed to forward linkages. The United States on the other hand saw almost static change from 2007 to 2012 in terms of composition, with the

exception of employment elasticity which saw the backward linkages decrease. Furthermore, the multipliers and coefficients decreased drastically. Even with the downturn in the economy, the manufacturing sector still held onto its backward linkages in terms of composition relative to the United States, which means the industry itself induces more output and employment if its final demand increases, then it provides to other sectors if their final demand should increase. In other words, if a policy was being targeted to assist the manufacturing sector in particular, then targeting it directly would be the best means with the highest benefit to other sectors, rather than relying on other sectors to boost production of the manufacturing sector via inputs from the manufacturing sector itself.

Table 10: Forward and Backward Output Linkages Manufacturing Sector 1992 to 2012

Forward and Backward Output Linkages Manufacturing Sector 1992 to 2012					
Multiplier	1992	1996	2001	2007	2012
Forward	2.91254	2.885288	3.110498	2.498902	2.002878
Backward	1.984477	2.077454	2.03919	1.974634	1.855024
Forward Percentage	59.48%	58.14%	60.40%	55.86%	51.92%
Backward Percentage	40.52%	41.86%	39.60%	44.14%	48.08%
Elasticity	1992	1996	2001	2007	2012
Forward	0.226928	0.19466	0.172457	0.130283	0.082082
Backward	0.163668	0.160918	0.134836	0.130817	0.111137
Forward Percentage	58.10%	54.74%	56.12%	49.90%	42.48%
Backward Percentage	41.90%	45.26%	43.88%	50.10%	57.52%

Source: Author's Calculations

Table 11: Forward and Backward Employment Linkages Manufacturing Sector 1992 to 2012

Forward and Backward Employment Linkages Manufacturing Sector 1992 to 2012					
Multiplier	1992	1996	2001	2007	2012
Forward	17.83879	14.4214	11.70148	4.593833	5.438705
Backward	15.34133	13.17627	10.09139	5.768957	5.964734
Forward Percentage	53.76%	52.26%	53.69%	44.33%	47.69%
Backward Percentage	46.24%	47.74%	46.31%	55.67%	52.31%
Elasticity	1992	1996	2001	2007	2012
Forward	0.193083	0.177046	0.170242	0.082142	0.081753
Backward	0.186552	0.201191	0.193244	0.157025	0.152134
Forward Percentage	50.86%	46.81%	46.84%	34.35%	34.95%
Backward Percentage	49.14%	53.19%	53.16%	65.65%	65.05%

Source: Author's Calculations

We determined the importance of a particular sector by the use of multiplier and elasticity coefficients, however, we can also determine total importance of a sector by the "shut down" method as defined previously. The direct importance of the manufacturing sector, a tradeable sector is logically measured by its own output or employment. However, this does not show the entire loss to an industry nor its overall importance due to forward and backward linkages. As we can only shutdown tradeable sectors, we only quantify the effects of a hypothetical shutdown of the manufacturing sector and determine its outward effects.

Table 12 below depicts this shutdown for Australia across the study period in relation to output. As expected, the overall loss increases from one data point to the next. From 1992 to 2012, we can see the direct output loss of the manufacturing sector initially increasing and then decreasing in size from 170,865.3 million to 347,884 million, the fall in the final year could be expected with the global financial crisis. However, due to sectorial flow on effects and multipliers, all other sectors of the economy actually exhibit an increase in output loss with an aggregate indirect change from 176,344 million to 1,001,393 million. Given the consistent increase from 1992 to 2007, we can stipulate that the manufacturing sector itself took a larger hit than other sectors during the global financial crisis within the economy, and given the data, the linkages actually grew in aggregate terms. In terms of output loss, the direct loss from 1992 to 2007 averages out to be about 44% of all loss with a drastic decrease in 2012 down to 26% arguably due to the global financial crisis. For ease of analysis, we transform each sector for all years into a composition of total loses for output (Table 13). As we can see, each sector composition changes with an emphasis on decreasing manufacturing output and increasing service output. These table demonstrate that the manufacturing sector has vital growing links to the service sector predominately as higher output loses will be evident for this sector alone relative to the manufacturing sector itself.

Table 12: Output ($M) Shut Down Approach With Losses Incurred 1992 to 2012

Output ($M) Shut Down Approach With Losses Incurred 1992 to 2012					
	1992	1996	2001	2007	2012
Agriculture	9349.003301	12950.26	15927.32	29880.74	32769.14281
Mining	8643.985919	13401.89	12975.97	27799.02	35791.79186
Manufacturing	170865.3	213558.5	276379.3	559676	347884
Construction	2887.25301	3285.041	59265.02	105387	165534.643
Trade	16715.60769	32254.43	43161.34	80009.1	100412.6586
Services	115561.6396	183022.6	258393.2	516434.9	595189.3633
Public Admin. Defence	6297.103213	4831.638	6738.516	9262.22	16281.5348
Utility	16889.20414	12466.72	22906.93	26519.6	55414.19541
Direct	170865.3	213558.5	276379.3	559676	347884
Indirect	176343.7969	262212.5	419368.3	795292.5	1001393.33
Total	347209.0969	475771	695747.6	1354969	1349277.33
Direct/Total	49%	45%	40%	41%	26%
Service/total	33%	38%	37%	38%	44%

Source: Author's Calculations

Table 13: Output Percentage Shut Down Approach With Losses Incurred 1992 to 2012

Output Percentage Shut Down Approach With Losses Incurred 1992 to 2012					
	1992	1996	2001	2007	2012
Agriculture	2.69%	2.72%	2.29%	2.21%	2.43%
Mining	2.49%	2.82%	1.87%	2.05%	2.65%
Manufacturing	49.21%	44.89%	39.72%	41.31%	25.78%
Construction	0.83%	0.69%	8.52%	7.78%	12.27%
Trade	4.81%	6.78%	6.20%	5.90%	7.44%
Services	33.28%	38.47%	37.14%	38.11%	44.11%
Public Admin. Defence	1.81%	1.02%	0.97%	0.68%	1.21%
Utility	4.86%	2.62%	3.29%	1.96%	4.11%
Direct	49.21%	44.89%	39.72%	41.31%	25.78%
Indirect	50.79%	55.11%	60.28%	58.69%	74.22%
Total	100%	100%	100%	100%	100%

Source: Author's Calculations

As output only informs us of one slice of the economy, we utilise the same shutdown method for employment which can be seen in table 14. We can see in 2012, that if the manufacturing sector was shut down completely, there would be 944,660 people that would lose their job directly, with an aggregate indirect loss of 285,020 from every other sector (127,218 from services alone), 3% of the entire workforce of the economy or an aggregate of 11% for both indirect and direct . As we did with output, we covert each sector

into a composition of the total. Table 15 outlines the employment composition which, from previous analysis, is unsurprising to see only the manufacturing and the service sector as major components. The area that is of most interest is the growing service component from only 0.89% in 1992 to 10.35% of total employment. Unlike our output analysis, the employment analysis depicts the manufacturing sector as still being a dominate sector in regards to itself and its on flow effects, none the less, there is a growing service component which, given the current data, could continue to become a larger and more important component of employment.

It should be noted that the composition change is from two effects, firstly and to a lesser extent the change is partly due to the decrease of employees in the manufacturing sector in aggregate and secondly, the change is also, to a larger extent, due to the growing linkages from the manufacturing sector to the rest of the economy which induces high employment losses indirectly, predominantly in the service sector. This second point can be seen with the large increase of employees job losses from out hypothetical shut down from 9,536 jobs to 127,218 in 1992 and 2012 respectively.

Table 14: Employment Shut Down Approach With Losses Incurred 1992 to 2012

Employment Shut Down Approach With Losses Incurred 1992 to 2012					
Employment	1992	1996	2001	2007	2012
Agriculture	606.2958	1094.45	1563.116	5242.038	7703.519
Mining	3129.169	6504.828	9077.946	32525.48	28890.28
Manufacturing	1046519	1067420	1039720	1028875	944660
Construction	269.6201	351.9146	11319.89	31259.17	65897.09
Trade	921.3818	2509.171	5497.536	10425.44	15354.92
Services	9535.854	19520.66	33648.33	97762.59	127218.1
Public Admin. Defence	1276.783	806.8611	1154.581	2657.16	5668.185
Utility	3647.213	3461.004	8738.548	13636.1	34287.42
Direct	1046519	1067420	1039720	1028875	944660
Indirect	19386.32	34248.89	70999.95	193508	285019.6
Total	1065906	1101669	1110720	1222383	1229680
Direct/Total	98%	97%	94%	84%	77%
Service/total	1%	2%	3%	8%	10%

Source: Author's Calculations

Table 15: Employment Percentage Shut Down Approach With Losses Incurred 1992 to 2012

Employment Percentage Shut Down Approach With Losses Incurred 1992 to 2012					
Employ Percentage	1992	1996	2001	2007	2012
Agriculture	0.06%	0.10%	0.14%	0.43%	0.63%
Mining	0.29%	0.59%	0.82%	2.66%	2.35%
Manufacturing	98.18%	96.89%	93.61%	84.17%	76.82%
Construction	0.03%	0.03%	1.02%	2.56%	5.36%
Trade	0.09%	0.23%	0.49%	0.85%	1.25%
Services	0.89%	1.77%	3.03%	8.00%	10.35%
Public Admin. Defence	0.12%	0.07%	0.10%	0.22%	0.46%
Utility	0.34%	0.31%	0.79%	1.12%	2.79%
Direct	98.18%	96.89%	93.61%	84.17%	76.82%
Indirect	1.82%	3.11%	6.39%	15.83%	23.18%
Total	100%	100%	100%	100%	100%

Source: Author's Calculations

We can utilise both the change in employment losses and the change in output losses across the time period to determine the growing importance of manufacturing in the wider economy. As seen, the indirect effects in aggregate and composition terms increase for both output and employment. This trend indicates that although the manufacturing sector itself is declining, the indirect effects via linkages are growing for both employment and output with an aggregate increase of 14.7 times and 5.7 times from 1992 to 2012 in employment and output respectively. Hence there is a growing indirect importance of the manufacturing sector within the Australia economy with emphasis on the service sector. Lastly, one could argue that the data from 2007 to 2012 can be a result and effect from the global financial crisis, however, in terms of our employment changes, firms have a tendency to hold onto employees and cut hours overall, rather than making them redundant due to higher costs associated with finding and training new employees when the economy starts to boom relative to holding onto existing employees. In other words, the decrease could arguably be a natural decline in manufacturing workers rather than effected by the global financial crisis.

This explanation is not true for output, as output is relative to demand and can be decreased or increased without difficulty, assuming the inputs to production are not at full production, which rarely occurs. Hence, the drastic decrease in output could be stipulated to be temporary. Furthermore the increase in the indirect service employment loss

composition begun early in the study and only intensified from data point to data point with the largest change occurring from 2001 to 2007 at 3.03% and 8% respectively.

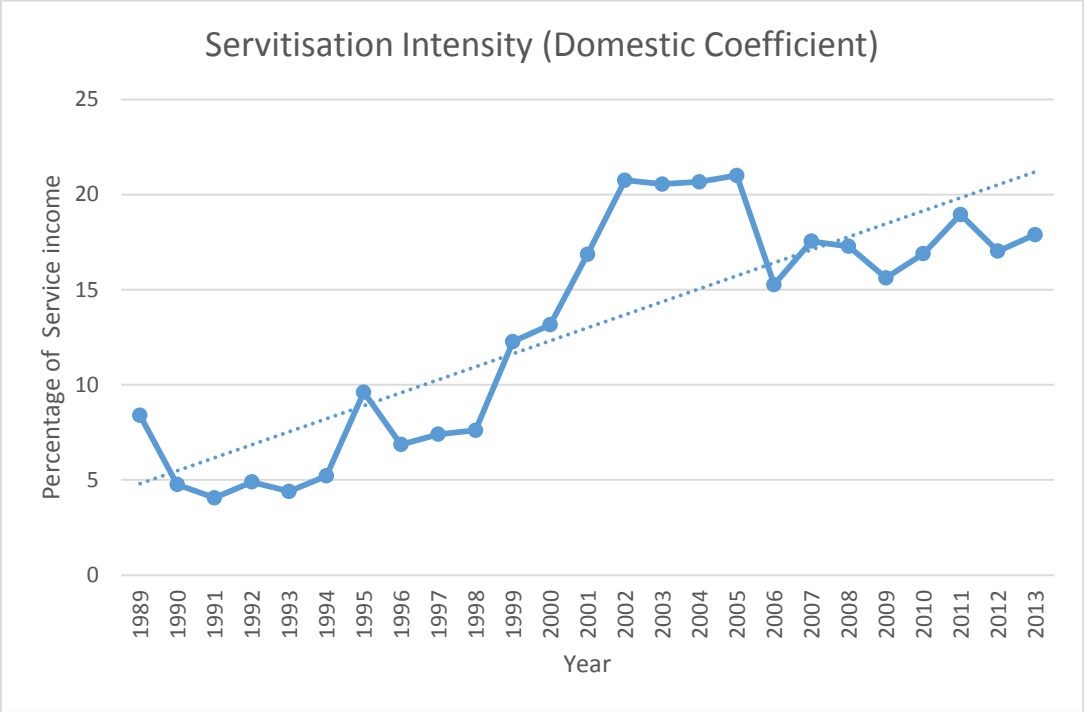
Utilizing linkages by the use of multipliers and elasticity coefficients and comparing these across time periods assists in analysing the trends between the manufacturing sector and other sectors. This however, does not give us a service intensity value. As stated previous, we will utilize service income as a percentage of total income which captures service output and to an extent the in-house services utilized in producing the output. Table 15 and Graph 1 demonstrates our service intensity value from 1989 to 2013 and increases over time from a low of 4.06% in 1991 to a high of 21.01% in 2005 with a decline to 17.90% in 2013. Graph 2 is the international servitise intensity coefficient derived from supply tables and provided for comparison.

Our servitisation intensity indicator appears to fluctuate in an almost cyclical nature across the time series, as such, coupled with the results presented previously, we can speculate that this trend will continue over time. The cyclical nature could possibly be due to the economic down turns that occurred in early 1990s and the recent global financial crisis (however, there is a decrease in service income from 2005 to 2006 which occurred prior to the onset of the global financial crisis) which would suggest that economic downturns influence service income more than goods income for the manufacturing sector, which is supportive of previous conclusion based on service employment. None the less, there is a clear increase in servitisation measured by our service intensity percentage derived from service income as a percentage of total income for the manufacturing sector.

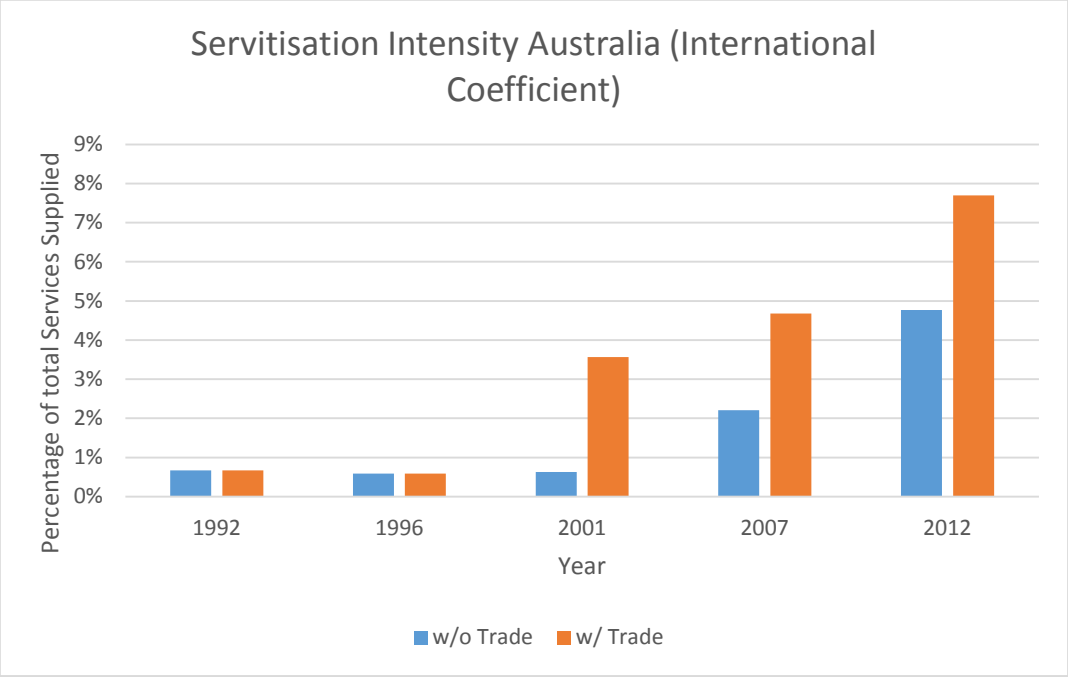
Table 16: Service Intensity Domestic Coefficient 1989 to 2013

Service Intensity Domestic Coefficient 1989 to 2013		
Year	Services $ (,000)	Service Intensity (%)
1989	14087473.12	8.39573542
1990	8144876.447	4.756268324
1991	6816790.75	4.057161941
1992	8109900	4.890248447
1993	7603600	4.40087837
1994	10270200	5.215266469
1995	19406500	9.618620567
1996	14206000	6.861147965
1997	15763400	7.401526001
1998	16748900	7.610234097
1999	29474200	12.2734912
2000	33131000	13.15981282
2001	49691200	16.87062691
2002	64195200	20.75612926
2003	64863000	20.55195577
2004	69962000	20.67190639
2005	75092000	21.00698816
2006	57692000	15.26526076
2007	69543053.5	17.54910164
2008	70941170.56	17.28459678
2009	59564192.21	15.6268787
2010	65673198.89	16.89699149
2011	75383806.4	18.95470422
2012	66688510.32	17.02766523
2013	69019336.28	17.89591032

Source: Author's Calculations



Graph 1: Servitisation Intensity (Domestic Coefficient)



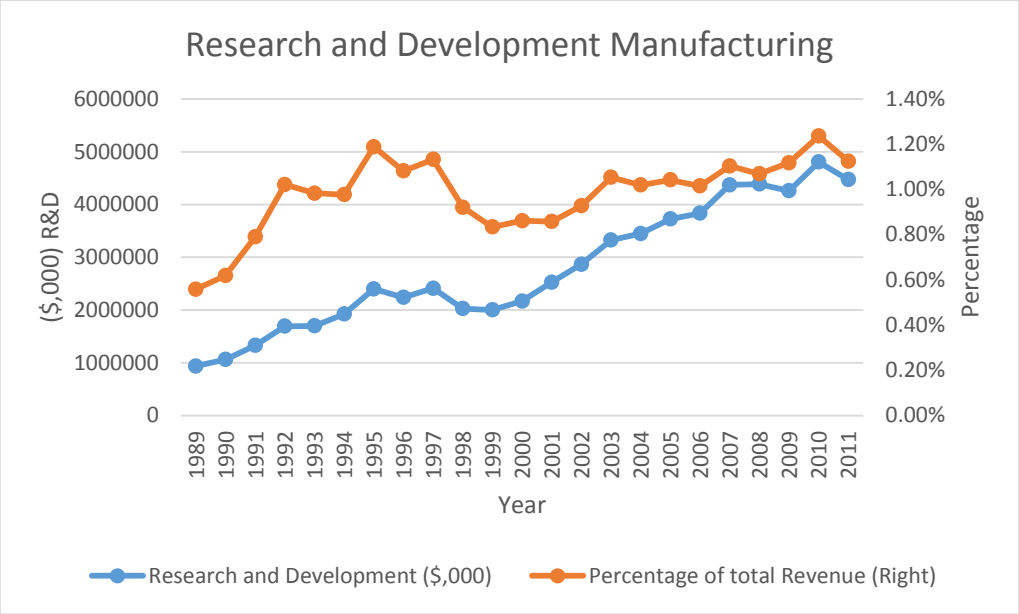
Graph 2: Servitisation Intensity Australia (International Coefficient)

Given the literature and results conducted by previous studies, we should expect to see anything but an increase in research and development expenditure within the Australian manufacturing sector as levels of servitisation increases in our aggregated data. Table 16 and graph 3 depict the total research and development expenditure by the manufacturing sector and as a percentage of total research and development of total revenue. The overall expenditure on research and development increases. We also notice that the percentage of total revenue follows a trend similar to that of total revenue spent, however, the increases are rather minute at a mean value of about 1%. One area that is expected to increase is the composition of high skilled labour relative to total labour. Table 17 and graph 4 represents the percentage of high skilled labour relative to total labour. As expected, from 1979 to 2013 education intensity increased from 2.77% to 17.19% of total labour within the manufacturing sector. This could be brought on by a mixture of three events, firstly, overall education in the Australia economy has risen from the early 1990s to the mid-2010s, secondly, due to the automation of activities that was once conducted by human labour, that is, the substitution of labour for capital and thirdly, higher manufacturing and the whole idea of servitisation requires higher skilled labour as inputs, such as design and output such as sales personal and analysts.

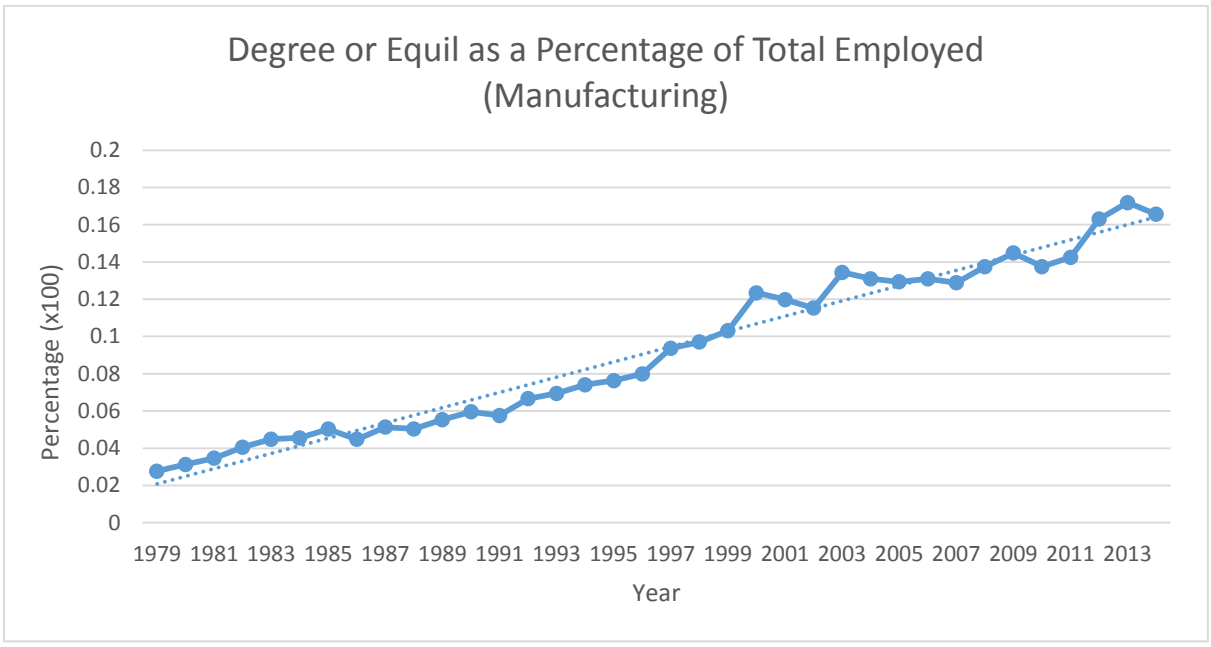
Table 17: Research Intensity 1989 to 2011

Research Intensity 1989 to 2011		
Year	R and D $ (,000)	Research Intensity
1989	937200	0.56%
1990	1060000	0.62%
1991	1327700	0.79%
1992	1694100	1.02%
1993	1699500	0.98%
1994	1924000	0.98%
1995	2399000	1.19%
1996	2240000	1.08%
1997	2412000	1.13%
1998	2027000	0.92%
1999	2002000	0.83%
2000	2170000	0.86%
2001	2528000	0.86%
2002	2868000	0.93%
2003	3326000	1.05%
2004	3451000	1.02%
2005	3724921	1.04%
2006	3835696	1.01%
2007	4373558	1.10%
2008	4388253	1.07%
2009	4260316	1.12%
2010	4804956	1.24%
2011	4473890	1.12%

Source: ABS 8104.0 - Research and Experimental Development and Author's Calculations



Graph 3: Research and Development Manufacturing



Graph 4: Degree or Equil as a Percentage of Total Employed (Manufacturing)

Table 18: High Skill Intensity 1979 to 2014

High Skill Intensity 1979 to 2014			
Year	Degree or Equil	Composition w/ Degree or Equil	Total Manufacturing
1979	35400	2.77%	1277700
1980	40800	3.13%	1303900
1981	45200	3.47%	1303900
1982	50400	4.05%	1243200
1983	51900	4.49%	1156300
1984	51800	4.55%	1137600
1985	58400	5.03%	1160800
1986	52200	4.48%	1166400
1987	58600	5.13%	1141600
1988	59500	5.04%	1181700
1989	67300	5.53%	1216000
1990	71800	5.96%	1205100
1991	66500	5.76%	1154200
1992	73400	6.66%	1101400
1993	76400	6.94%	1100700
1994	81800	7.40%	1104700
1995	84400	7.63%	1105600
1996	87100	7.99%	1090300
1997	104200	9.37%	1112300
1998	105300	9.70%	1085400
1999	108600	10.31%	1052900
2000	144700	12.34%	1172700
2001	124900	11.98%	1042500
2002	126500	11.53%	1097600
2003	147600	13.44%	1098200
2004	141000	13.09%	1076900
2005	135400	12.93%	1047100
2006	135500	13.10%	1034700
2007	131600	12.88%	1021900
2008	145200	13.75%	1055800
2009	140000	14.48%	967000
2010	132500	13.75%	963500
2011	139100	14.25%	976300
2012	157400	16.30%	965600
2013	159800	17.19%	929700
2014	152500	16.56%	921100

Source: ABS 6291.0.55.003 - Labour Force, Australia, Detailed, Quarterly and Author's Calculations

Country Comparison

Determining Australia's servitisation level by services utilized by the manufacturing sector and services sold or otherwise utilized as an output for the sector does little in isolation as this does not allow us to use a benchmark. In other words, the servitisation level of the Australian manufacturing sector could have reached a point which is significant enough to cause a difference within the sector, employment, output or otherwise. Furthermore, Australia could be one of the leading nations on the global stage or falling behind other OECD nations. We derive and compare employment, output and common service intensity variable coefficients for Germany, the United States and Sweden. The first two nations, Germany and the United States, were selected as they are and have historically been at the forefront of the manufacturing frontier. The final nation, Sweden, although not historically a large manufacturing nation, has been at the forefront of servitisation academia with the government utilizing resources to support a growing level of services within the manufacturing sector. We employ 2007 as our reference year for two reasons. Firstly, it places all nations on a level playing field as we mitigate the effects of the global financial crisis which impacted each nation differently and hence can skew results. Secondly, input output tables are not derived for each country on a consistent basis nor created for every year, with 2007 being one of the latest years for all countries included.

We first compare the service output used within the manufacturing sector, which is shown in Table 18 (See appendix J and appendix K for full tables for Germany and Sweden respectively). For comparison purposes, we display both the multiplier and the percentage of total inputs for the manufacturing sector. Australia has both the lowest multiplier and percentage composition of services utilised at 0.34 and 16.97% respectively. Germany has the highest multiplier at 4.8 and 53.78% of inputs with Sweden a close second at 3.55 and 48.93% with the United States in between Australia and Sweden. We compute the elasticity of each country as the absolute coefficients determined previously can understate or overstate a sector depending on its size. Table 19 depicts a few intriguing results (See appendix M and N for full tables for Germany and Sweden respectively). Firstly, Australia almost triples its percentage composition of service outputs used as inputs for the manufacturing sector at 40.46%. Similarly, every other nation's percentage composition increases, however, by a lesser amount. Secondly, even though Australia is still falling

behind in service outputs utilized, due to the skewed increases, the gap exhibited by the multipliers is not as large as once assumed. Lastly, the relative increase in the percentage indicates that the service sector, for the manufacturing sector at least, is significantly important relative to other inputs.

Table 19: Output Multiplier Country Comparison 2007

Output Multiplier Country Comparison 2007				
	AU	US	DE	SE
Multiplier	0.33518	2.357517	4.804475	3.545457
Percentage	16.97%	39.64%	53.78%	48.93%
Difference		22.67%	36.81%	31.95%

Source: Author's Calculations

Table 20: Output Elasticity Country Comparison 2007

Output Elasticity Country Comparison 2007				
2007	AU	US	DE	SE
Elasticity	0.052925	0.074426	0.077593	0.080718
Percentage	40.46%	65.31%	56.36%	59.29%
Difference		24.85%	15.90%	18.84%

Source: Author's Calculations

Each nation in the study contains different employment conditions in regards to population and their composition of labour force split among the sectors with Australia and Sweden containing smaller populations and Germany and the United States containing relative larger labour forces. Hence our composition percentages are vital in this instants to compare data. Table 20 depicts the multipliers for employment service inputs into the manufacturing sector across our four economies (See appendix M and N for Germany and Sweden respectively for full tables). From this, we can clearly see Australia falling behind in service employment resources utilized at about half of the other three economies at 30.69% with our other three economies exhibiting over 60% of service employment utilisation. Once again, we use elasticity coefficient to determine true importance of service inputs into the manufacturing sector for each economy. Table 21 shows these results which depicts a slightly different picture with the United States percentage coefficient as high as 81.25% (See appendix P and Q for Germany and Sweden respectively for full tables). Although Australia is still behind at 61.06% the gap has been closed relative to all three nations with Australia behind the next leader Germany by 9.95 percentage points. These similar gap minimising results we saw previously in regards to output.

Table 21:Employment Multiplier Country Comparison 2007

Employment Multiplier Country Comparison 2007				
	AU	US	DE	SE
Multiplier	1.770604	14.37461	36.65906	20.4479
Percentage	30.69%	60.54%	63.30%	62.72%
Difference		29.85%	32.61%	32.03%

Source: Author's Calculations

Table 22: Employment Elasticity Country Comparison 2007

Employment Elasticity Country Comparison 2007				
	AU	US	DE	SE
Elasticity	0.095887	0.684656	1.194626	1.114736
Percentage	61.06%	81.25%	71.01%	75.33%
Difference		20.19%	9.95%	14.27%

Source: Author's Calculations

The shutdown method is used for each country in our comparison for 2007 and is shown in table 23 for output and table 24 for employment losses given a shutdown in the manufacturing sector. In regards to output, Australia is regards to composition of direct and indirect losses is the outlier, with 41% of its output losses coming directly from manufacturing, whereas the other three nations range from 17% to 27%. None the less, all four nation's manufacturing sectors are well integrated in terms of output due to a larger percentage of losses occurring from other sectors in aggregate. We can disaggregate this analysis further to the losses incurred for the service industry (and any other sector). As we can see, Australia has the lowest amount of service output loss at 38% of total output loss with the highest being the United States at 66%. From 2007 at least, we can state that Australia is less integrated with the service sector than any other nation conducted in the study, however, as this is only one data point, and given from our cross section analysis seen previously, the service sector is a growing proportion of total loss and hence Australia might be playing catch up in terms of service integration. Service employment losses are a lower proportion of total losses with manufacturing still the dominate sector, however, one needs to keep in mind that the manufacturing sector itself employs an ever growing proportion of employees that are involved in service orientated activities and are captured here as manufacturing employees. Australia only surpasses Germany by 1% with the United States and Sweden at higher percentiles being 20% and 13% respectively for employment composition. All four nations contain low employment service linkages relative to output

service linkages, however, the service sector is still ranked as second in importance only to manufacturing itself. Table 25 and table 26 outlines the composition of each sector for output and employment respectively, which depicts manufacturing and services as the dominate sectors which is supported by previously derived multipliers.

Table 23: Output ($M) Shut Down Approach With Losses Incurred Country Comparison 2007

Output ($M) Shut Down Approach With Losses Incurred Country Comparison 2007				
	AU	US	DE	SW
Agriculture	29880.74	854463.6	74465.92	19896.14
Mining	27799.02	559931.6	11922.82	3236.733
Manufacturing	559676	5359107	2295313	277887.3
Construction	105387	671524.8	246335	45398.62
Trade	80009.1	2038690	472534.7	62543.59
Services	516434.9	21382962	4955071	660267.6
Public Admin. Defence	9262.22	534860.9	102213.1	29868.36
Utility	26519.6	969219.7	348202.4	33764.85
Direct	559676	5359107	2295313	277887.3
Indirect	795292.5	27011652	6210745	854975.9
Total	1354969	32370759	8506058	1132863
Direct/Total	41%	17%	27%	25%
Service/total	38%	66%	58%	58%

Source: Author's Calculations

Table 24: Employment Shut Down Approach With Losses Incurred Country Comparison 2007

Employment Shut Down Approach With Losses Incurred Country Comparison 2007				
	AU	US	DE	SW
Agriculture	5242.038	1729298	6179.237	6895.627
Mining	32525.48	291181	2093.687	1469.12
Manufacturing	1028875	11214165	8391000	693243
Construction	31259.17	128808.3	27628.55	8990.96
Trade	10425.44	253954.6	46457.42	10523.2
Services	97762.59	3506926	649403.3	114483.7
Public Admin. Defence	2657.16	82700.46	10028.85	4502.502
Utility	13636.1	628226.3	172924.8	14742.75
Direct	1028875	11214165	8391000	693243
Indirect	193508	6621094	914715.9	161607.8
Total	1222383	17835259	9305716	854850.8
Direct/Total	84%	63%	90%	81%
Service/total	8%	20%	7%	13%

Source: Author's Calculations

Table 25: Output Percentage Shut Down Approach With Losses Incurred Country Comparison 2007

Output Percentage Shut Down Approach With Losses Incurred Country Comparison 2007				
	AU	US	DE	SW
Agriculture	2%	3%	1%	2%
Mining	2.05%	1.73%	0.14%	0.29%
Manufacturing	41.31%	16.56%	26.98%	24.53%
Construction	7.78%	2.07%	2.90%	4.01%
Trade	5.90%	6.30%	5.56%	5.52%
Services	38.11%	66.06%	58.25%	58.28%
Public Admin. Defence	0.68%	1.65%	1.20%	2.64%
Utility	1.96%	2.99%	4.09%	2.98%
Direct	41.31%	16.56%	26.98%	24.53%
Indirect	58.69%	83.44%	73.02%	75.47%
Total	100.00%	100.00%	100.00%	100.00%

Source: Author's Calculations

Table 26: Employment Percentage Shut Down Approach With Losses Incurred Country Comparison 2007

Employment Percentage Shut Down Approach With Losses Incurred Country Comparison 2007				
	AU	US	DE	SE
Agriculture	0.43%	9.70%	0.07%	0.81%
Mining	2.66%	1.63%	0.02%	0.17%
Manufacturing	84.17%	62.88%	90.17%	81.10%
Construction	2.56%	0.72%	0.30%	1.05%
Trade	0.85%	1.42%	0.50%	1.23%
Services	8.00%	19.66%	6.98%	13.39%
Public Admin. Defence	0.22%	0.46%	0.11%	0.53%
Utility	1.12%	3.52%	1.86%	1.72%
Direct	84.17%	62.88%	90.17%	81.10%
Indirect	15.83%	37.12%	9.83%	18.90%
Total	100.00%	100.00%	100.00%	100.00%

Source: Author's Calculations

We compare each country's backward and forward linkages within the manufacturing sector. Although these are not specific for the service and manufacturing sector, it does assist in determining the importance of Australia's manufacturing sector relative to other nations as higher backward linkages than forward linkages would induce relatively more economic output than forward to backward linkages. Table 27 and Table 28 depicts the multipliers and elasticity for output and employment respectively with the composition

derived for simpler comparison. It is interesting to see a higher composition of backward linkages than forward linkages for Australia relative to the other three nations in regards to both output and employment. Of course, the multipliers themselves are vastly lower for Australia than any of the other three countries and having higher overall multipliers is preferable over higher backward linkages in regards to inducing higher output. We calculate the elasticity of each nation for the manufacturing sector which gives familiar results. Lastly, Australia is the only nation with higher backward linkages than forward linkages for the manufacturing sector in regards to both output and employment.

Table 27: Forward and Backward Output Linkages Manufacturing Sector Country Comparison 2007

Forward and Backward Output Linkages Manufacturing Sector Country Comparison 2007				
Multiplier	AU	US	DE	SE
Forward	2.498902	16.80174	13.64064	11.83977
Backward	1.974634	7.16017	8.933047	7.246239
Forward Percentage	55.86%	70.12%	60.43%	62.03%
Backward Percentage	44.14%	29.88%	39.57%	37.97%
Elasticity	AU	US	DE	SE
Forward	0.130283	0.186382	0.284501	0.246301
Backward	0.130817	0.113962	0.137674	0.13613
Forward Percentage	49.90%	62.06%	67.39%	64.40%
Backward Percentage	50.10%	37.94%	32.61%	35.60%

Source: Author's Calculations

Table 28: Forward and Backward Employment Linkages Manufacturing Sector Country Comparison 2007

Forward and Backward Employment Linkages Manufacturing Sector Country Comparison 2007				
Multiplier	AU	US	DE	SE
Forward	4.593833	31.09991	49.86621	29.53657
Backward	5.768957	23.74292	57.91408	32.60299
Forward Percentage	44.33%	56.71%	46.27%	47.53%
Backward Percentage	55.67%	43.29%	53.73%	52.47%
Elasticity	AU	US	DE	SE
Forward	0.082142	0.588418	2.098588	1.471321
Backward	0.157025	0.842608	1.682288	1.479784
Forward Percentage	34.35%	41.12%	55.51%	49.86%
Backward Percentage	65.65%	58.88%	44.49%	50.14%

Source: Author's Calculations

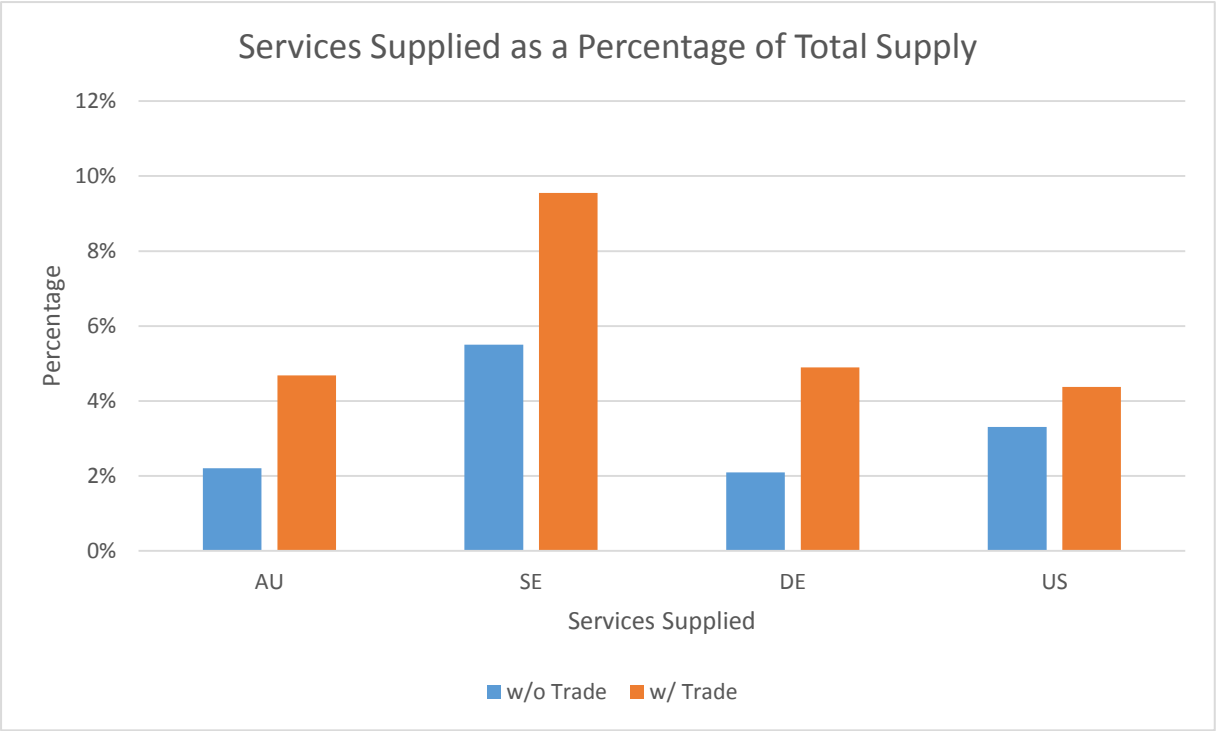
Service income for the manufacturing sector is difficult to obtain as it is either not reported as a single variable and is often aggregated within goods income or total income. As such,

the data obtained and utilized as our service intensity percentage is difficult to compare to several other economies. None the less, we are able to compare the services supplied by manufacturing firms to the rest of the economy by utilizing supply tables. Table 28 depicts four OECD nations, Australia, Sweden, the United States and Germany compared in the reference year 2007. We have aggregated the data into two data sets, firstly as total services inclusive of retail and wholesale trade and secondly as services without retail and wholesale trade as these have been seen to drastically increase coefficients, skew the data, and are not always directly related to servitisation. As the results show, Sweden clearly has a higher service intensity rate relative to the other three nations which is unsurprising given the push for services in the manufacturing sector. It is interesting to see large manufacturing countries such as Germany and to an extent the United States with a low servitisation intensity rate, comparable to Australia, a nation that is not often considered to be one of the leading nations in manufacturing. This could be due to previous thought that servitisation is a form of innovation and hence profitable manufacturing nations would have lesser need to undergo servitisation comparable to small manufacturing nations that would need to compete with nations that have economies of scale.

Table 29: Supply of Services Manufacturing Sector Country Comparison 2007

Supply of Services Manufacturing Sector Country Comparison 2007						
Country	AU	T($M)	Perc	DE	T($M)	Perc
w/o Trade		8372	2.21%		34948	2.09%
w/ Trade		17736	4.68%		81718	4.90%
Total of Manu		378974			1668520	
Country	SE	T($M)	Perc	US	T($M)	Perc
w/o Trade		102728	5.50%		176331.2	3.31%
w/ Trade		178382	9.55%		233157.9	4.37%
Total of Manu		1868311			5332768	

Source: Author's Calculations



Graph 5: Services Supplied as a Percentage of Total Supply

Chapter 5

Discussion

The amount of services that the manufacturing sector utilizes within Australia has not only been increasing, but the relative importance of these services has become apparent. We could stipulate that these increases are due to a competitive advantage by developing and emerging nations in regards to low cost inputs into the manufacturing process, predominantly low cost labour. As the manufacturing process still requires some form of labour, it appear that Australia is unable to compete with the use of technology alone, which we can see with Australia's car manufacturing in the process of off-shoring their plants to low cost nations. Transfer costs theory can also shed light on this ongoing phenomena as the cost involved in transactions is high relative to emerging nations, for example, the cost of moving resources from one point to another in China is far lower than attempting to move the same amount of goods in Australia. For a manufacturing firm, these costs cut into profit margins as they can only sell at the market rate, where they are competing with firms that produce in lower cost environments. To offset these costs, firms within the manufacturing sector would diversify themselves and move up the value chain which can be seen with an increase in service income. Furthermore, the use of input services such as research and development and design would allow manufacturing firms to produce not only diversify their products by coupling output of goods with services but also high valued manufactured products which requires higher skilled labour. These higher skilled labour requirements have become evident within Australia which has been a growing composition of total employment within the manufacturing industry.

We cannot state that servitisation has been occurring at a significant level within Australia simply from using the multipliers, as they have either changed very little (as a composition of the entire simple multiplier) or have decreased, either by the global financial crisis or from other unknown reasons. We can see this from the output linkages starting to decrease from 2001 to 2012 after increasing from 1992 to 2001 and employment multiplier linkages increasing from 1992 to 2007 with smaller increases from dataset to dataset but decreasing from 2007 to 2012. Similarly, on the global stage, utilising just these multipliers puts Australia at about half the level of services utilised in the manufacturing sector for both

employment and output in 2007. However, as stated previously, these multipliers can be misleading, hence, our elasticity coefficients demonstrate depict a different view. Firstly, both our service outputs and employment coefficients either increase year to year or stay stationary, which indicates that services in both employment and output are being used at an increasing level as inputs for the manufacturing sector. On a global stage, Australia is still seen behind the other three nations included in the study, but the gap is not as pronounced as we saw with the multipliers. With the notable leader being the United States inducing 81.25% employment from services and 65.31% of service output in the manufacturing sector. Whereas Australia sits at 61.06% and 40.46% for service employment and output respectively. It is important to state here, that just because Australia is behind other nations in output and employment services does not mean in the future that Australia will continue to use less service inputs than global peers, or that these levels will plateau, in fact, the increase, albeit small, from dataset to dataset suggests that the service composition of inputs will increase.

Our second method of determining linkages and hence changes in servitisation levels utilises the “shutdown” approach. We noticed a greater change in employment services than output of services with linkages to the manufacturing sector. Firstly, in regards to output, our composition changed very little, albeit, a small increase n services with a decline in manufacturing (2007 to 2012 had a large decrease in manufacturing which could be explained by the GFC). These results are replicated in regards to employment, in fact, from the time period studied, we can see a drastic change in employment services, in both aggregate terms and overall composition. Furthermore, the manufacturing sector induced almost exclusively manufacturing employment which has changed to include predominantly manufacturing and service employment from 1992 to 2012. Our global comparison analyse depicts Australia behind all three nations as is the case for output with other nations in the respected manufacturing sectors and their linkages to other sectors in 2007. Although our analysis using multipliers and elasticity coefficients previously discussed demonstrates similar trends, the magnitude shown in out “shutdown” model is more pronounced. This difference is due to how each technique uses the data for the final use, that is, multiplier and elasticity coefficients are based on the average change in final demand and the subsequent average change in any given sector, here we are calculating our composition

based on these total multipliers. On the other hand the “shutdown” method tracks aggregate changes based on the entire sector essentially being removed from the economy and here we are calculating our composition percentages on total aggregate amounts rather than a coefficient change.

As majority of the study focuses on the manufacturing sector and its links back to the service sector, and indeed, a few studies on servitisation focus on the same area, we decided to take a detour and analysed the service sector’s forward links to every other sector to determine the importance of the manufacturing sector to the service sector and more precisely, if the manufacturing sector was becoming a larger part of the service sector compared to any other sector. When we think servitisation and the idea that services are becoming a larger part of the manufacturing sector, we can also often make the connection that the manufacturing sector would become an ever increasing part of the service sector. However, the data from 1992 to 2012 in regards to employment and output suggests otherwise. In fact, in terms of composition both are rather static in nature relative to other sectors of the economy. As the service sector is the major sector of the Australian economy constituting 70.4% of value added to GDP in 2014, and hence the higher linkages from the service sector would reap the most rewards, it is difficult to ignore that the linkages to the manufacturing sector have not grown as proportion of the total economy.

As input output tables for our purposes focus mainly on the inputs of services into the manufacturing sector, and as servitisation has predominantly been seen on the output side of the manufacturing industry, we created our service intensity coefficient via this side. We would have liked to compare our service intensity coefficient which was derived from service income from 1989 to 2013, unfortunately, service income is not reported in an easy fashion and is hence difficult to compute. None the less, our service intensity coefficient demonstrates a non-linear almost cyclical increasing trend in servitisation. This could mean one of two related occurrences, firstly, a small number of firms have been intensifying their service offerings and/or increase in sales of service oriented output or secondly, firms across the manufacturing sector have started to sell services. Although we do not conduct firm level analysis in this paper, we can stipulate from other literature that a u-shape idea of servitisation is also occurring in Australia, that is, smaller and larger firms are selling more services with medium firms selling fewer services. In addition, we included time series data

on education and research and development. Without this paper going into regression analysis, the data appears to follow existing saturated literature for other OECD nations, that is, an increase in composition of skilled labour relative to unskilled labour is correlated to servitisation and research and development having a weak to no correlation on servitisation due to a consistent 1% of revenue expenditure (however this might be different from individual manufacturing industries). Of course, these areas would be additional areas of future study along with other key variables that may or may not have an influence on servitisation. As stated previously, we also compute a service intensity coefficient that can be comparable on the global stage. The coefficient derived is vastly smaller than our previous coefficient, however, in terms of country comparison analysis, the coefficient still gives an indication of Australia relative to other nations. It should be noted, that this coefficient, like our last coefficient, is computed based on output of the manufacturing industry, and hence, although it captures a large proportion of servitisation, it can still understate the true level due to services conducted inside the firm and input services to production. The results are however consistent with the rest of our analysis, given that Sweden is pushing for servitisation to reindustrialise itself, we would expect a higher coefficient than other nations. The situation in Germany and the United States is slightly different as these nations are leaders in manufacturing and have had little reason thus far to push for an alternate forms of manufacturing and hence are similar to Australia in a lower level of servitisation.

We utilised the “shutdown” method as another means of testing the effects of servitisation across the study period by linkages as this gives a slightly different perspective by depicting aggregate results rather than changes in sector j due to a unit or percentage change in final demand. Our hypothetical shutdown of the manufacturing industry has given a few clear results with the highest change occurring in employment with a slight change occurring in output itself, both in composition terms. In aggregate terms, both employment and output have increased with the earlier depicting the more drastic change. Our global comparison indicates that Australia’s servitisation intensity is behind in the case of output and employment relative to Germany, the United State and Sweden.

The following section will compare our expectations based on existing literature to the actual data and hence either confirm or deny our expectation.

Expectation 1: Servitisation of the Australia manufacturing sector will increase over the period 1992 to 2012 in terms of output and employment and hence become a more important role within the economy.

We expected that the servitisation of the Australian manufacturing sector would increase for the period 1992 to 2012 in terms of output and employment. We can state that for both employment and output, the manufacturing sector demonstrates a larger proportion of service employment linkages relative to other employment inputs from other sectors which has also been increasing across the period. This is true in aggregate terms deemed by the multiplier and in importance determined by the elasticity. The changes in servitisation for output and employment are supported by our shutdown model which depicts service employment growing in composition and aggregate terms with linkages to the manufacturing sector. An examination of the pure output side to servitisation for the manufacturing exhibits significant change. As we utilised two service intensity components, we will look at these in tandem. Both our domestic coefficient and our international coefficient derived from service income and supply tables respectively show a clear increase in services. This informs us that the manufacturing sector is increasing obtaining revenue from service orientated activities relative to the tradition manufacturing of goods. These results confirm that total servitisation of the manufacturing sector has increased over the period 1992 to 2012. We determined the importance of the manufacturing sector to other sectors by the use of the shutdown model. We conclude here, that the manufacturing sector has had an increasing importance in employment for other sectors, notably the service sector. In addition, we find an increase in importance with the service sector and a lesser importance to every other sector in regards to output across the study period, including manufacturing itself which is declining for both output and employment. Hence we can confirm our first expectation with emphasis placed on service outputs from the manufacturing sector and employment used inputs from the service sector.

Expectation 2: Australia will not be a leading nation at the forefront of servitisation in regards to developed nations.

We selected three nations which were either considered leading developed manufacturing nations (Germany, United States) or had been pushing to servitise its manufacturing sector (Sweden). A cross-nation analysis was conducted for employment, output and servitisation

intensity as well as the shutdown approach. As a multiplier is relative to an economy, we use the composition percentage derived to compare Australia to the other three nations. We find that Australia is behind our three nations in output and employment multipliers with employment at about half of that of the next leader nation and output almost two thirds behind that of the next leader nation. When we determine the importance of the manufacturing sector for each nation by the use of the elasticity coefficient relative to other sectors we obtain a slightly different story. Australia still has a lower coefficient for both employment and output we find that the gap between Australia and the next leading nation has closed significantly. In regards to employment, the coefficient is only 9.95 percentage points behind that of the next nation, being Germany and 14.27 percentage points behind that of Sweden (our expected servitised nation). Surprisingly, the United States has the highest coefficient in service employment importance. Output has a similar story with Australia tailing behind the next leading nation by a larger gap of 15.90 percentage points and 18.84 percentage point for our perceived servitised nation Sweden.

When we compared the nations in terms of output of services by our servitisation intensity coefficient, the data supports the above discussion. However, if we look at output services from the manufacturing industry without retail and wholesale trade , Australia has a slightly higher servitisation intensity coefficient than Germany. This slightly higher coefficient is however, rather insignificant being 0.12 percentage points above that of Germany. Sweden, as expected, has the highest servitisation intensity coefficient at over double that of Australia.

The shutdown method for all four nations demonstrates similar results to our multipliers and elasticity coefficients with two key observations. Firstly, in regards to output, Australia is behind other nations in the Study, however, the gap is smaller than what we would expect from analysing previous linkages with an 8 percentage point difference. Secondly, Australia is ranked second in regards to employment, only surpassed by the United States by 6 percentage points and only slightly ahead of Sweden by an insignificant 0.07 percentage points.

Australia is slightly ahead of a nation or nations in some areas of the analysis, such as employment in the shutdown method with Germany and Sweden and our servitisation intensity with Germany. However, majority of the findings put Australia behind our three

nations, and in some cases, by a significant amount such as the output and employment linkages derived from multiplier and elasticity coefficients. As such, we can conclude that Australia is not a leader at the forefront of servitisation for the manufacturing industry, specifically, in regards to employment and output.

Expectation 3: The manufacturing sector within Australia has been an increasing important sector for the service industry.

Our analysis of the compositional change depicts are rather unexpected conclusion. We can see an almost stagnate change from year to year moving around a mean of 8.45% of forward linkages going to the manufacturing sector from the service sector. In fact, for 2012 we can see the manufacturing sector as the second lowest taker of service inputs. This is surprising given that the manufacturing sector's composition of service inputs has been growing in aggregate and composition terms. The major taker of service inputs is the service sector itself with minor takers being trade and construction, with a minor taker being any sector taking greater than 10% of service inputs. We can state based on our forward linkages of the service sector that the manufacturing sector within Australia has not been an increasing important sector for the service industry, but rather, has stayed stagnate at an average of 8.45% of service inputs.

Implications

The manufacturing sector at face value is shrinking, with total employees in the sector decreasing from 1,046,519 in 1992 to 944,659 in 2012, a decrease of 101,860 people over a 20 year period with output growing slower than other dominate areas such as services. This may suggest that the industry is dying and devoting finite resources to the industry may seem economically irresponsible. These face value statistics fail to capture linkages from the manufacturing sector to other sectors, predominantly, the service sector, where the number of employees has been growing from 19,386 in 1992 to 285,020 in 2012, an increase of 265,624 people over a 20 year period. Hence, growing linkages from the manufacturing sector to other sector, predominantly the service sector, will lead to indirect effects on a greater number of people, leading to an overall decrease in both employment and output. If, for one reason or another, Australia's manufacturing industry became completely non-existent, priced out of the market or otherwise, then the industry itself will directly lose 944,660 people, however, the economy will also indirectly lose 285,020 jobs (127,218 from services), a total of 1,229,680 or 11.12% of the entire workforce. Similarly, the economy will directly lose 347,884 $Million in output with an indirect loss of 1,001,393 $Million (595,189 $Million from services). These figures are derived from 2012 data and the potential losses have been growing exponentially from 1992 and hence will be even greater as time progresses. As majority of the losses will come from the service sector, the linkages between the manufacturing and the service sector are substantial. These changes have a number of specific implications for the employment and output of the Australian economy. This is more pronounced given that Australia is going through a period of economic structural change from the tradition resource based sector to other sectors in the economy. The manufacturing sector is decreasing in terms of direct workers, however, the linkages that cause indirect employment have actually grown to the point that the gains not only mitigate the losses, but exceed them (predominately in the service sector). It should be noted that the gains from investing in the manufacturing sector are still dwarfed by the gains in the service, trade and construction sector (Refer to appendix G5 and appendix H5). The higher benefits from construction should be taken lightly, as construction is not necessarily a long term sector and has little export potential, whereas manufacturing can be formed to grow with exports. Exporting for the Australian manufacturing sector, however, is

difficult as many of Australian manufacturing firms are SME's and hence typically do not undertake export orientated activities. This might be connected to the lower level of servitisation relative to other nations, as export growth has been correlated with servitisation. The low level of employment and output potential relative to other sectors is not comparable to the United States, Germany and Sweden, which all depict large gains from their manufacturing sectors which are only second to services. A growing manufacturing sector with increasing linkages could see this result for Australia, however, the current trend that Australia is on and its corresponding data suggests otherwise with decreasing aggregate elasticity coefficients for the manufacturing sector. Short term gains would be gained from investing and looking at other higher interlinked sectors, such as services, trade and construction, however, longer term gains could be created from pushing servitisation of the manufacturing sector as these have beared fruit over the period and could reach levels of other developed nations.

The manufacturing sector itself appears to be going through a period of servitisation from as far back as 1992 to 2012. As such, manufacturing firms should be seen as both producers of goods and producers of services, as well as users of both. A higher utilisation of services will also bring with it higher induced benefits for the service sector which will bring about benefits for the rest of the economy via indirect means. As such, an environment should be established that allows for the process to continue. Although Australia's manufacturing sector has been going through the process of servitisation, it is still behind that of other developed nation and this could have further implications for Australia, particularly if these nations export to Australia or the same trading partner. This problem is twofold, firstly, the idea of servitisation is about innovation and to utilise a competitive advantage to survive. If other firms in other nations are doing exactly this, but Australia is not, then the apparently competitive advantage could be lost and hence these firms have no method of survival within Australia, which, will further promote off-shoring. Secondly, and concurrently, if these firms do off-shore or are simply priced out of the market, then these growing linkages, particular with the service sector, will decrease, which will see a percentage of the losses derived from our shutdown model become a reality.

An economy should be diversified to protect itself from economic fluctuations and to take advantage of value adding chains, as such, countries are often looking at ways to diversify

their own economies. Within the economy, it is natural to look at sectors as individual units, so, by this logic, to diversify you would simply grow different sectors. This however, is misguided, as we can see with servitisation, the manufacturing sector is becoming both a service and goods provider. This does not mean, however, that the manufacturing sector should be lumped in with the service sector, or at least, it shouldn't anytime soon. This does mean, however, that it becomes simpler to diversify an economy with the use of the manufacturing sector, as a growing proportion of the sector utilises services, which is already a large proportion of the Australian economy. At the same time, this grows services, an area of the economy that is seen as a competitive advantage for Australia and increasing, as it is with any developed nation, with high skilled labour. Hence via these growing linkages both sectors complement and grow one another.

It is known that the manufacturing sector devotes the highest amount of financial capital towards research and development. Growing levels of servitisation would mean a growing proportion of higher skilled labour would be utilised, as we saw with our own skilled labour time series. Although research and development, in itself may not induce servitisation, the process of servitisation could result in higher levels of real research and development via higher skilled labour linkages, an area that has yet to be studied.

In regards to the public sector, policy frameworks that influence the manufacturing sector will need to take into account value creation and the new methods that manufacturing firms are developing to achieve these processes. A flow of highly skilled worker and long term capital would be critical. Government policy should conceptualise that manufacturing firms are no longer just good producers but service providers and users. As such, quality and skills of the workforce are critical, government will need to ensure and focus on the supply of these workers, including upskilling schemes, support for researchers and sufficient skills management. On the firm level, manufacturers would need to create teams to developed complex products and service bundles. The current image of the manufacturing sector also needs to be tweaked. That is, as stated previously, the manufacturing sector is seen as a good producers, not a service provider, which means many skilled workers in areas other than traditional manufacturing would not think to look at the manufacturing sector. Importantly, the structural change in the manufacturing sector to accommodate services is a long road, and hence the support of the above should be long term. None the less, if the

manufacturing sector increases its use and sale of services, often coupled with the goods it sells, then the sector as a whole can become more competitive and increase its linkages to other sectors of the economy which will promote greater indirect benefits. Lastly, although exporting has been see to be correlated with servitisation, it is not the only method to achieve levels such as Sweden. Previous studies have concluded that a u-shape servitisation rate does exist in relation to firm size. As Australia operates primarily from smaller firms, this environment is still ideal for the process, primarily through customised goods and service packages for the cliental as this is where small firms would have a competitive advantage over larger firms that operate with economies of scale.

Chapter 6

Conclusion

The servitisation of the manufacturing sector is not a new phenomenon, however, the process has been intensifying with growing linkages between the manufacturing sector and the service sector for both output and employment. The process itself has assisted in mitigate losses of employment via indirect means and improved overall output across the economy. These linkages, however, for Australia are not as the same level as other developed nations, them being, Sweden, the United States and Germany, and as such, the manufacturing sector is still dwarfed in terms of dollar for dollar return by the service sector, where as in the other developed nations, manufacturing is only slightly behind with greater linkages to not only services but the rest of the economy. We can state that servitisation within Australian manufacturing sector is an important driver for output and employment within itself, however, goods manufacturing is still predominate and as stated previously, the linkages are not as strong as other sectors and as they are for other nations which leads to dollar for dollar gains being found in other sectors. If the Australian economy does push for the servitisation route, which is present in all three developed nations, then the manufacturing sector itself could see a growing amount of linkages which will increase overall employment and output not only in its own sector, but across the economy via indirect linkages. This, however, at present state with present data does not appear to be occurring and hence the manufacturing sector will continue to decline in dollar to dollar gains relative to other dominate sectors being services, trade and construction.

Although the research has yielding some key results, there are a few significant limitations present within the paper. Firstly, the limitations of input output analysis as discussed previously which simplifies the overall model and can create unrealistic results in some circumstances. Secondly, although we looked at both the inputs used by the manufacturing sector and the outputs sold by the manufacturing sector and identified servitisation by these two areas, there is a third area which is internal servitisation. That is, services produced or utilised that are internalised, which has been estimated to be up to half of all operations within the manufacturing firm. Thirdly, our time period used could be examined earlier than 1992, that is, greater than a 20 year period and a complete data time series

created. The later of these two is difficult as input-output tables are only created for certain years and differ depending on the country which makes cross country analysis increasingly difficult. Lastly, as we utilised countries that either have a relatively larger manufacturing sector or perceived higher level of servitisation rates, Australia could still be ranked rather well relatively to other developed nations which this study does not capture.

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Appendices

Appendix A – Input Output Model Explanation

The Input output models are planning tools that utilize final demand and are hence used to determine linkages throughout the productive sectors of an economy. Input output tables utilize matrices which show the flow of goods and services between industries. The complete analysis utilizes four quadrants which depict the process of production, the way in which income and value added are generated within certain areas of an economy and the use of goods and services. The Input Output analysis tool is a useful method for tracing resources and products within an economy by basing the analysis on the production side of the economy, regardless of the sector.

The input and outputs within the analysis tool is insensitive to the level of production. This is the result of using the linear Leontief production function which assumes proportionality with zero economics of scale. This means that interpretation of either the total aggregates or the coefficients derived from these aggregates are not marginal but could be rather interpreted as averages. For example, if 10 computers require 10 silicon chips, then 100 computers would require 100 silicon chips. As each industry requires input to produce its output, these are obtained from other domestic industries or from supplier that are non-domestic, hence, it depicts how industries are linked together via supply chains.

IO tables are one of the very few tools (others discussed later) that have been developed to analyse complete links throughout the economy, that is, not only the direct links but the indirect links. For example, if a computer company needs silicon chips, these are direct inputs, then, the silicon that is required for the silicon chips are an indirect input. If there is a change in the supply chain, for example, the price of silicon changes then the IO tables can do this in a systematic way (Stilwell et al, 2000). Furthermore, more direct techniques can be used to assess the significance of a sector in relation to output, incomes and employment by the use of multipliers and utilizing the direct and indirect effect occurring within a selected sector.

The first quadrant of the IO table represents the supply (rows) and use (columns). This is the called the intermediate quadrant and is often expressed as the main part of the entire IO analysis. If we add the final demand quadrant (sectoral distribution of household,

government consumption, expenditure, fixed capital formation, and exports), the primary inputs quadrant (wages, surplus, value added, indirect taxes, subsidies and non-competitive imports) and finally the primary input to final demand quadrant, the IO system will be considered closed. Even though IO analysis is older than newer analysis tools, the techniques that can be employed include economic impact analysis, forward and backward linkages, employment creation (on average not at the margin), income distribution, project appraisal, cost- benefit analysis, regional planning, price-quantity relationships and energy analysis among others. All analysis techniques, however, require the use of the Leontief matrix and associated multipliers. Direct multipliers can be easily observed from the IO table itself, however indirect contributions from other sectors can only be observable from creating income, employment or output multipliers for the given sector or in aggregate. This can be vital for some industries relative to others. For example, public administration would create higher direct employment multipliers than indirect multipliers, however, the service sector could possibly generate a much higher indirect multiplier relative to public administration due to backward linkages in the supply chain. Hence, the analysis would need to take into account both direct and indirect multipliers.

With any economic model, the basic supply and demand principles apply, and the input output model is no exception. When industry *j* increases its production (supply), there would be an increased demand for input from other industries. The IO model refers to this process as a *backward linkage*. Industries with higher backward linkages relative to other industries means the expansion of its production will have positive impact through the rest of the economy in terms of inducing higher output, employment or income depending on the analysis being performed. The other side of the coin refers to *forward linkages* which is where an increase in production by other industries leads to additional output required from industry *i* to supply inputs to match the demand. Industries with higher forward linkages than other industries means that its production is more sensitive to the output of other industries. An industry with higher backward linkages than forward linkages will tend to have a larger effect on the economy if it had higher forward linkages than backward linkages. We derive both backward and forward linkages for Australia with emphasis on backward linkages to determine service inputs into the manufacturing sector and comparing this from 1992 to 2012 at 5 year intervals or where applicable. In addition, these multipliers

will be compared with Sweden, Germany and the United States for basic comparison analysis.

Following Valadkhani (2003) a theoretical model is proposed to measure the indirect sectorial contribution to aggregate output and employment using an input-output system. The following known relation is utilised:

$(I - A)x = f$ (1)

Where:

A is the direct coefficient matrix

X is the vector of sector output

F is the vector of final demand; and

I is the identity matrix

We can write equation (1) as follows:

$$\begin{bmatrix} (1-a_{11}) & -a_{12} & -a_{13} & \cdots & -a_{1n} \\ -a_{21} & (1-a_{22}) & -a_{23} & \cdots & -a_{2n} \\ -a_{31} & -a_{32} & (1-a_{33}) & \cdots & -a_{3n} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ -a_{n1} & -a_{n2} & -a_{n3} & \cdots & (1-a_{nn}) \end{bmatrix} \cdot \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} f_1 \\ f_2 \\ f_3 \\ \vdots \\ f_n \end{bmatrix} \quad (2)$$

We can write this in the following fashion to measure the indirect significance of a particular (say sector 1) to assume that it is shut down and that pre-determined variables appear on the right hand side. However, we must make three assumptions first. First, the other n x 1 sectors which used to buy inputs from sector one can now buy these inputs via importing. Second, the shutdown of the sector has no effect on the technology on other sectors. Third, the distribution of sector final demand remains unchanged. As we know the out of sector 1 prior to the shut down and we know the final demand, we can write the equation as follows:

$$\begin{bmatrix} 1 & -a_{12} & -a_{13} & \cdots & -a_{1n} \\ 0 & (1-a_{22}) & -a_{23} & \cdots & -a_{2n} \\ 0 & -a_{32} & (1-a_{33}) & \cdots & -a_{3n} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ 0 & -a_{n2} & -a_{n3} & \cdots & (1-a_{nn}) \end{bmatrix} \cdot \begin{bmatrix} f_1 \\ x_2 \\ x_3 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} (1-a_{11})x_1 \\ f_2 + a_{21}x_1 \\ f_3 + a_{31}x_1 \\ \vdots \\ f_n + a_{n1}x_1 \end{bmatrix} \quad (3)$$

This allows us to compute the changes in sectoral output with equation (3) and the following equation.

$$\begin{bmatrix} \Delta f_1 \\ \Delta x_2 \\ \Delta x_3 \\ \vdots \\ \Delta x_n \end{bmatrix} = \begin{bmatrix} 1 & -a_{12} & -a_{13} & \cdots & -a_{1n} \\ 0 & (1-a_{22}) & -a_{23} & \cdots & -a_{2n} \\ 0 & -a_{32} & (1-a_{33}) & \cdots & -a_{3n} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ 0 & -a_{n2} & -a_{n3} & \cdots & (1-a_{nn}) \end{bmatrix}^{-1} \cdot \begin{bmatrix} (1-a_{11})x_1 \\ f_2 + a_{21}x_1 \\ f_3 + a_{31}x_1 \\ \vdots \\ f_n + a_{n1}x_1 \end{bmatrix} \quad (4)$$

Box 2 Simplifying assumptions of input-output multiplier analysis

The assumption that average input-output relationships apply to a marginal change requires that:

- there is a fixed input structure in each industry, described by fixed technological coefficients;
- all products of an industry are identical or are made in fixed proportions to each other;
- each industry exhibits constant returns to scale in production;
- there is unlimited labour and capital available at fixed prices — so that, any change in the demand for productive factors will not induce any change in their cost; and
- there are no other constraints, such as the balance of payments or the actions of government, on the response of each industry to a stimulus.

Source: On input-output tables: uses and abuses (Gretton, 2013, p. 4)

Appendix D1 – Employment Multiplier Australia 1992

1992 Emp Mult AU	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	16.79843279	0.224963355	1.60676666	0.485051893	0.223490848	0.30354431	0.311721142	0.124849623	20.07882
Mining	0.055177361	2.994076696	0.196234929	0.07876441	0.026972684	0.03206185	0.038527594	0.347546316	3.769362
Manufacturing	2.051825094	0.946555159	8.714650499	2.466021227	0.967839349	0.84869274	1.272565649	0.570636747	17.83879
Construction	0.055862837	0.102028265	0.031722451	10.73854742	0.046329607	0.07239117	0.234482794	0.053213399	11.33458
Trade	1.274581747	0.652886994	1.493058743	1.112644103	18.68085276	0.72000833	0.759153218	0.36579069	25.05898
Services	2.860732989	2.70341359	3.07861904	3.18049381	4.207186359	15.5927526	4.523782073	1.766990012	37.91397
Public Admin. Defence	0.033930126	0.014402281	0.035861895	0.038646418	0.031307084	0.02824563	5.572980574	0.017147938	5.772522
Utility	0.166673397	0.277240894	0.184414959	0.096386197	0.077754227	0.18795955	0.09191197	6.22027961	7.302621
Backwards	23.29721634	7.915567234	15.34132918	18.19655548	24.26173292	17.7856562	12.80512501	9.466454335	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix D2 – Employment Multiplier Australia 1996

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	13.16002354	0.183036	1.24057	0.391434	0.235702	0.19735	0.197547	0.130019	15.73568
Mining	0.042982168	2.297167	0.155974	0.069871	0.03066	0.023815	0.031329	0.265585	2.917385
Manufacturing	1.47310437	0.907424	6.983547	1.976103	0.931392	0.640033	0.881175	0.628627	14.4214
Construction	0.04859763	0.069353	0.026547	9.362303	0.046511	0.049571	0.183783	0.033473	9.820138
Trade	1.457386251	0.747727	1.298506	1.011233	13.53958	0.638011	0.945817	0.816166	20.45443
Services	2.565749838	2.504487	3.298995	2.897508	5.174352	12.17089	3.353038	2.333165	34.29819
Public Admin. Defence	0.032400571	0.047478	0.03434	0.026606	0.034365	0.02428	6.396771	0.022667	6.618908
Utility	0.071727198	0.114538	0.137796	0.060203	0.072947	0.071102	0.078495	4.034101	4.640909
Backwards	18.85197157	6.871208	13.17627	15.79526	20.06551	13.81505	12.06795	8.263804	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix D3 – Employment Multiplier Australia 2001

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	11.69791	0.145174	0.919836	0.286566	0.400638	0.130373	0.191803	0.113388	13.88569
Mining	0.0121	1.587137	0.057511	0.02321	0.029933	0.008356	0.013573	0.070455	1.802276
Manufacturing	0.821108	0.696553	5.1076	1.437425	1.815255	0.405007	0.89083	0.5277	11.70148
Construction	0.123605	0.221646	0.136341	7.216382	0.468528	0.155269	0.567607	0.471077	9
Trade	0.749769	0.662823	0.978712	0.783599	9.746792	0.413731	0.521218	0.544417	14.40106
Services	1.744872	2.523698	2.766796	3.450832	6.73943	10.79837	2.774618	2.803897	33.60252
Public Admin. Defence	0.018239	0.035343	0.035951	0.050072	0.098171	0.039734	5.988697	0.029458	6.295666
Utility	0.057241	0.056664	0.088647	0.090713	0.14461	0.040364	0.065381	2.813165	3.356785
Backwards	15.22485	5.929039	10.09139	13.3388	19.44336	11.99121	11.01373	7.373557	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix D4 – Employment Multiplier Australia 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	6.618574904	0.080915497	0.599256029	0.17147546	0.13678	0.09780177	0.075497	0.0538	0.053803972
Mining	0.009397661	0.938599447	0.042443525	0.01678305	0.01384	0.00701554	0.007527	0.06084	0.060838911
Manufacturing	0.385433666	0.271559427	2.437450855	0.58508335	0.27322	0.23234276	0.231325	0.17742	0.177419669
Construction	0.111027531	0.285692077	0.083117955	4.61136796	0.12088	0.09555676	0.179801	0.0661	0.066097717
Trade	0.735104003	0.396383273	0.757782176	0.66313544	8.27648	0.46488854	0.373342	0.30546	0.305455408
Services	1.618653051	1.361153407	1.770603751	2.70886816	2.64651	7.58547639	2.034604	1.31777	1.317770407
Public Admin. Defence	0.012491079	0.014701744	0.021513301	0.02157722	0.01952	0.03191577	3.521548	0.01925	0.019248831
Utility	0.038514763	0.043714668	0.056789183	0.05591633	0.02998	0.03371206	0.038228	2.13217	2.132174555
Backwards	9.529196658	3.392719539	5.768956776	8.83420698	11.5172	8.54870959	6.461872	4.13281	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix D2 – Employment Multiplier Australia 2012

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	5.091676822	0.054097	0.449140261	0.112651	0.082149	0.047694491	0.036201004	0.022648676	5.896258135
Mining	0.018981837	1.331459	0.078259293	0.038653	0.019668	0.013019202	0.011715128	0.050694235	1.56244947
Manufacturing	0.406745575	0.266305	3.319553427	0.716054	0.239017	0.186117005	0.18677542	0.118137678	5.438704581
Construction	0.117965116	0.202571	0.079188253	3.613915	0.105568	0.100618007	0.172268408	0.040084512	4.432178314
Trade	0.515040779	0.349574	0.59100066	0.54022	6.962273	0.409562497	0.28539522	0.204296053	9.857361763
Services	1.132111871	1.517566	1.353438369	1.803281	2.018273	6.500669663	1.5531295	1.279727572	17.1581972
Public Admin. Defence	0.011920023	0.025519	0.02086911	0.037359	0.022007	0.027423873	2.928003056	0.01262189	3.085722326
Utility	0.046732248	0.06495	0.073284842	0.044793	0.045769	0.040030532	0.054124242	2.05229461	2.421978095
Backwards	7.341174269	3.81204	5.964734216	6.906925	9.494724	7.32513527	5.227611978	3.780505226	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix E1 – Employment Multiplier United States 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.788496	0.051010494	0.082216654	0.058472783	0.046649728	0.055391664	0.058004708	0.03764	1.177878904
Mining	0.186614	2.294927611	0.130686637	0.128396565	0.137157486	0.161270644	0.160837499	0.88317	4.083057456
Manufacturing	4.272521	3.543043234	5.866668137	4.012252584	3.161937885	3.776131471	3.868410075	2.59895	31.09991429
Construction	0.440709	0.57353665	0.341854576	5.558103124	0.390705006	0.462574687	0.694676468	0.56076	9.02291671
Trade	3.096575	2.058277454	2.344006935	3.145886457	10.24607284	1.733776564	2.288088051	1.46185	26.37453591
Services	16.90581	17.31583778	14.37460979	16.3810833	18.57846633	26.68325247	19.71763821	14.05448	144.0111722
Public Admin. Defence	0.53512	0.460607217	0.399537659	0.404757041	0.462632543	0.516056251	7.034136261	0.35697	10.16981943
Utility	0.251635	0.250300552	0.203336691	0.189536565	0.200617425	0.226504457	0.231337512	1.70782	3.261089336
Backwards	26.47748	26.54754099	23.74291708	29.87848842	33.22423924	33.61495821	34.05312878	21.66163	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix E2 – Employment Multiplier United States 2012

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	6.028159067	0.0506832	0.4501299	0.11986041	0.1636367	0.40972	0.069048	0.040737694	7.331974786
Mining	0.079230733	1.5356413	0.2515837	0.0747897	0.0940041	0.223099	0.044584	0.139767785	2.4427005
Manufacturing	0.872688079	0.3529588	3.304706	0.79983452	1.1131178	2.635675	0.46055	0.293146616	9.832677041
Construction	0.064865026	0.0682804	0.0473524	5.29150454	0.1193966	0.407376	0.12903	0.065310432	6.193115233
Trade	12.77582818	9.2940969	0.6921121	0.91927009	15.224713	1.852999	0.240285	0.187021785	41.1863252
Services	1.414710261	1.0894745	1.7091209	1.24338114	11.827334	52.2087	1.672455	1.049364065	72.21454366
Public Admin. Defence	0.017978841	0.0089455	0.0248064	0.01504229	0.2189943	0.318299	6.450196	0.015918933	7.070180854
Utility	0.028587062	0.0147188	0.0295181	0.01269742	0.0297909	0.134964	0.019703	1.526849189	1.796827893
Backwards	21.28204724	12.414799	6.5093294	8.47638011	28.790988	58.19083	9.085851	3.318116498	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix F1 – Output Multiplier Australia 1992

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forward
Agriculture	1.08940169	0.014589186	0.104201049	0.031456289	0.014493692	0.01968527	0.020215549	0.008097	1.30213
Mining	0.0199745	1.083871729	0.071038091	0.028513136	0.009764255	0.011606562	0.013947194	0.125814	1.36452
Manufacturing	0.33500163	0.154544131	1.422841631	0.402627468	0.158019202	0.138566126	0.207771887	0.093168	2.9125
Construction	0.00521663	0.009527695	0.002962334	1.002796707	0.004326393	0.006760097	0.021896683	0.004969	1.05845
Trade	0.07025628	0.035987814	0.08229896	0.061330107	1.029708146	0.039687612	0.041845319	0.020163	1.38127
Services	0.23606046	0.223078858	0.254039864	0.262446312	0.347166387	1.286674547	0.373291066	0.145808	3.12856
Public Admin. Defence	0.00687958	0.002920166	0.007271256	0.007835838	0.006347735	0.005727004	1.129961675	0.003477	1.1704
Utility	0.03599301	0.059869991	0.03982429	0.020814536	0.016790975	0.040589742	0.01984833	1.343265	1.57699
Backwards	1.79878379	1.584389569	1.984477475	1.817820394	1.586616785	1.54929696	1.828777704	1.74476	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix F2 – Output Multiplier Australia 1996

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	1.112177587	0.015468746	0.104842793	0.033081	0.01992	0.016678	0.016695066	0.010988153	1.329851203
Mining	0.020862106	1.114967903	0.075704686	0.033913	0.014882	0.011559	0.015206127	0.12890621	1.41600097
Manufacturing	0.294723735	0.181548083	1.397197116	0.395359	0.186344	0.128051	0.176296467	0.125769246	2.885287987
Construction	0.005206089	0.007429547	0.002843913	1.00295	0.004983	0.00531	0.019687963	0.003585815	1.051995879
Trade	0.11337458	0.058167959	0.101014761	0.078667	1.053286	0.049633	0.073578006	0.063492102	1.591212954
Services	0.27365544	0.267121271	0.351861225	0.30904	0.551881	1.298112	0.357625358	0.248848596	3.658145045
Public Admin. Defence	0.005410744	0.007928549	0.005734586	0.004443	0.005739	0.004055	1.068230982	0.003785296	1.105326731
Utility	0.01991287	0.031797867	0.038254929	0.016714	0.020251	0.019739	0.021791687	1.11994526	1.288406949
Backwards	1.84532315	1.684429926	2.077454008	1.874166	1.857285	1.533138	1.749111656	1.705320677	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix F3 – Output Multiplier Australia 2001

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility
Agriculture	1.148039713	0.01424748	0.090273203	0.028123729	0.039318833	0.012794875	0.018823669	0.011127968
Mining	0.008465002	1.11035618	0.040234841	0.01623787	0.020941057	0.005845662	0.00949574	0.049290416
Manufacturing	0.218267726	0.185158484	1.357707069	0.382097591	0.482532693	0.10765933	0.236801303	0.140273755
Construction	0.023609072	0.042335442	0.026041753	1.378362083	0.08949099	0.029657035	0.108415509	0.089977827
Trade	0.09549946	0.084424927	0.124660246	0.099808452	1.241466241	0.052697694	0.06638852	0.069343424
Services	0.22721973	0.328639538	0.360296161	0.449372278	0.877618277	1.406179749	0.361314714	0.365127468
Public Admin. Defence	0.003125097	0.006055747	0.006159916	0.008579289	0.016820653	0.006808122	1.026106495	0.005047351
Utility	0.021836236	0.021616405	0.033817088	0.034605223	0.055165947	0.015398083	0.024941543	1.073167685
Backwards	1.746062034	1.792834203	2.039190275	2.397186514	2.823354692	1.63704055	1.852287493	1.803355894

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix F4 – Output Multiplier Australia 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forward
Agriculture	1.16110994	0.01419517	0.105128693	0.03008229	0.023994805	0.017157561	0.01324462	0.009438939	1.37435
Mining	0.01099548	1.09818266	0.049659888	0.01963656	0.016191984	0.008208343	0.00880703	0.071182907	1.28286
Manufacturing	0.20966393	0.14771988	1.325897454	0.31826714	0.148622231	0.126387236	0.12583339	0.096510781	2.49890
Construction	0.03293224	0.08474006	0.024653887	1.36779284	0.035855666	0.0283434	0.05333141	0.019605459	1.64725
Trade	0.09578641	0.05165001	0.098741444	0.08640867	1.078452271	0.060576465	0.04864764	0.039801818	1.56006
Services	0.30641565	0.25767023	0.33518035	0.51279648	0.50099209	1.43595236	0.38515628	0.249457704	3.98362
Public Admin. Defence	0.00358346	0.00421766	0.006171768	0.00619011	0.0055995	0.009156045	1.01026684	0.005522133	1.0507
Utility	0.01980388	0.02247762	0.029200395	0.02875158	0.015417965	0.017334384	0.01965658	1.09634152	1.24898
Backwards	1.84029098	1.68085328	1.974633879	2.36992567	1.825126511	1.703115794	1.66494379	1.587861262	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix F5 – Output Multiplier Australia 2012

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	1.1969745	0.012717423	0.105585931	0.026482521	0.019311865	0.011212237	0.008510296	0.005324354	1.386119127
Mining	0.015321687	1.074722139	0.063169039	0.03119952	0.015875507	0.01050879	0.009456172	0.04091918	1.261172035
Manufacturing	0.149789636	0.098070359	1.222471076	0.263696523	0.088021388	0.06854014	0.06878261	0.04350582	2.002877553
Construction	0.04696031	0.080640951	0.031523768	1.438650284	0.042025198	0.040054662	0.068577713	0.0159571	1.764389987
Trade	0.078759111	0.053456188	0.09037476	0.082609508	1.064658223	0.062629562	0.043642125	0.031240586	1.507370061
Services	0.241982105	0.324370534	0.289289313	0.385440518	0.431393793	1.389479052	0.331972092	0.273534073	3.66746148
Public Admin. Defence	0.004149787	0.008884047	0.007265285	0.013005962	0.007661282	0.009547232	1.019342735	0.004394132	1.074250462
Utility	0.028915478	0.040187441	0.04534484	0.027715428	0.028319614	0.024768806	0.033489259	1.269852908	1.498593775
Backwards	1.762852615	1.693049082	1.855024012	2.268800264	1.69726687	1.616740481	1.583773003	1.684728153	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix G1 – Output Multiplier United State 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	1.595791	0.103237	0.166393	0.11834	0.09441159	0.112104	0.117392	0.07617	2.383839
Mining	0.097045	1.19343	0.067961	0.06677	0.07132594	0.083865	0.08364	0.459273	2.12331
Manufacturing	2.041784	1.693175	2.803606	1.917405	1.51105003	1.804565	1.848664	1.242005	14.86225
Construction	0.084534	0.110013	0.065573	1.066126	0.07494297	0.088729	0.133249	0.107562	1.730728
Trade	0.385733	0.256395	0.291987	0.391875	1.27632856	0.215972	0.285022	0.182099	3.285412
Services	2.772648	2.839895	2.357517	2.68659	3.04697307	4.376204	3.233804	2.305013	23.61864
Public Admin. Defence	0.082741	0.071219	0.061777	0.062584	0.07153247	0.079793	1.087622	0.055195	1.572462
Utility	0.163104	0.162239	0.131798	0.122853	0.13003568	0.146815	0.149948	1.106971	2.113764
Backwards	7.223379	6.429603	5.946613	6.432543	6.27660032	6.908047	6.93934	5.534288	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix G2 – Output Multiplier United State 2012

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	1.3019591	0.0109465	0.09721885	0.0258874	0.035342189	0.08849109	0.014912968	0.0087985	1.583556631
Mining	0.0573272	1.1111099	0.18203283	0.05411392	0.068016423	0.161423085	0.032258526	0.1011287	1.767410531
Manufacturing	0.4247718	0.171799	1.60853109	0.38931109	0.541798473	1.282887238	0.224168033	0.1426861	4.78595278
Construction	0.0123086	0.0129567	0.00898544	1.00409978	0.022656344	0.077302354	0.02448438	0.0123931	1.17518668
Trade	1.7963667	1.3068121	0.09731558	0.12925551	2.140696264	0.260543967	0.033785606	0.0262965	5.791072204
Services	0.2735847	0.2106888	0.33051954	0.24045213	2.287237332	10.09641664	0.323428971	0.202932	13.96526014
Public Admin. Defence	0.0028001	0.0013932	0.00386349	0.00234276	0.034107317	0.049573494	1.004587459	0.0024793	1.101147151
Utility	0.018905	0.0097337	0.01952073	0.00839698	0.019701117	0.08925325	0.013029764	1.0097261	1.188266732
Backwards	3.8880233	2.8354399	2.34798754	1.85385958	5.149555459	12.10589112	1.670655708	1.5064403	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix H1 – Employment Elasticity Australia 1992

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.020825552	0.000278894	0.00199196	0.000601334	0.000277069	0.00037631	0.000386451	0.00015478	0.024892
Mining	0.000135176	0.007335014	0.000480745	0.00019296	6.60788E-05	7.8546E-05	9.43865E-05	0.000851433	0.009234
Manufacturing	0.022208548	0.010245325	0.09432565	0.026691725	0.010475701	0.00918608	0.013773998	0.006176459	0.193083
Construction	0.000345751	0.000631482	0.000196339	0.066463968	0.000286747	0.00044805	0.001451282	0.000329353	0.070153
Trade	0.008799848	0.004507602	0.010308237	0.007681814	0.128974602	0.00497101	0.005241275	0.002525458	0.17301
Services	0.073373649	0.069338634	0.078962109	0.081575049	0.107908223	0.39993147	0.116028444	0.045320729	0.972438
Public Admin. Defence	0.000143655	6.09772E-05	0.000151834	0.000163623	0.00013255	0.00011959	0.023595188	7.26019E-05	0.02444
Utility	0.000121703	0.000202438	0.000134657	7.03799E-05	5.67751E-05	0.00013725	6.71129E-05	0.004541967	0.005332
Backwards	0.125953883	0.092600367	0.186551531	0.183440854	0.248177746	0.41524831	0.160638137	0.059972781	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in employment in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix H2 – Employment Elasticity Australia 1996

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.023732724	0.000330087	0.002237	0.000706	0.000425	0.000355901	0.000356256	0.000234476	0.028378
Mining	0.000129569	0.006924773	0.00047	0.000211	9.24E-05	7.17913E-05	0.000094441	0.000800603	0.008794
Manufacturing	0.018084683	0.011140058	0.085734	0.02426	0.011434	0.007857416	0.010817811	0.007717386	0.177046
Construction	0.000362726	0.000517642	0.000198	0.069879	0.000347	0.000369991	0.001371728	0.000249836	0.073296
Trade	0.013573723	0.006964134	0.012094	0.009418	0.126104	0.00594227	0.008809095	0.007601564	0.190507
Services	0.077897619	0.076037629	0.100159	0.08797	0.157096	0.369515144	0.101800146	0.070836205	1.041312
Public Admin. Defence	0.000138428	0.000202843	0.000147	0.000114	0.000147	0.000103735	0.027329431	9.68423E-05	0.028278
Utility	7.90267E-05	0.000126194	0.000152	6.63E-05	8.04E-05	0.000078338	0.000086483	0.004444643	0.005113
Backwards	0.133998497	0.10224336	0.201191	0.192624	0.295727	0.384294585	0.150665391	0.091981556	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in employment in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix H3 – Employment Elasticity Australia 2001

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.023753	0.000295	0.001868	0.000582	0.000814	0.000265	0.000389	0.000230	0.028195
Mining	0.000046	0.006042	0.000219	0.000088	0.000114	0.000032	0.000052	0.000268	0.006861
Manufacturing	0.011946	0.010134	0.074309	0.020913	0.026410	0.005892	0.012960	0.007677	0.170242
Construction	0.001083	0.001942	0.001195	0.063235	0.004106	0.001361	0.004974	0.004128	0.082023
Trade	0.009500	0.008399	0.012401	0.009929	0.123501	0.005242	0.006604	0.006898	0.182475
Services	0.064910	0.093883	0.102926	0.128372	0.250710	0.401704	0.103217	0.104306	1.250028
Public Admin. Defence	0.000104	0.000201	0.000204	0.000285	0.000558	0.000226	0.034061	0.000168	0.035807
Utility	0.000079	0.000078	0.000122	0.000125	0.000199	0.000056	0.000090	0.003870	0.004617
Backwards	0.111421	0.120973	0.193244	0.223529	0.406410	0.414777	0.162348	0.127545	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in employment in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix H4 – Employment Elasticity Australia 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.012260786	0.000149894	0.001110111	0.00031766	0.00025	0.00018118	0.00014	1E-04	0.014512524
Mining	7.53703E-05	0.007527673	0.000340402	0.0001346	0.00011	5.6265E-05	6.04E-05	0.00049	0.008793607
Manufacturing	0.006891916	0.004855738	0.043583913	0.01046184	0.00489	0.00415451	0.004136	0.00317	0.082142045
Construction	0.001896832	0.00488086	0.001420015	0.07878216	0.00207	0.00163252	0.003072	0.00113	0.094878625
Trade	0.013938296	0.007515817	0.014368296	0.0125737	0.15693	0.00881474	0.007079	0.00579	0.227011796
Services	0.087657799	0.073712963	0.095886656	0.14669816	0.14332	0.4107898	0.110184	0.07136	1.139613671
Public Admin. Defence	0.000109198	0.000128523	0.00018807	0.00018863	0.00017	0.00027901	0.030786	0.00017	0.032017861
Utility	8.66459E-05	9.8344E-05	0.000127757	0.00012579	6.7E-05	7.5841E-05	8.6E-05	0.0048	0.00546455
Backwards	0.122916843	0.098869812	0.15702522	0.24928254	0.3078	0.42598387	0.155542	0.08701	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in employment in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix H5 – Employment Elasticity Australia 2012

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	
Agriculture	0.014049466	0.000149	0.001239313	0.000311	0.000227	0.000131603	9.98894E-05	6.24945E-05	0.016269547
Mining	0.000252636	0.017721	0.001041579	0.000514	0.000262	0.000173277	0.000155921	0.000674707	0.020795166
Manufacturing	0.0061141	0.004003	0.049898713	0.010764	0.003593	0.002797665	0.002807562	0.001775817	0.081753274
Construction	0.002440193	0.00419	0.001638066	0.074756	0.002184	0.002081356	0.003563496	0.000829177	0.091682797
Trade	0.007497042	0.005088	0.00860273	0.007864	0.101344	0.005961678	0.004154273	0.002973776	0.143485833
Services	0.074684807	0.100113	0.089285596	0.118961	0.133144	0.428845657	0.102459112	0.084422935	1.131916976
Public Admin. Defence	0.0001278	0.000274	0.000223747	0.000401	0.000236	0.000294023	0.031392418	0.000135325	0.033083396
Utility	0.000130208	0.000181	0.000204191	0.000125	0.000128	0.000111536	0.000150804	0.005718235	0.006748271
	0.10530	0.131719	0.152133935	0.213696	0.241117	0.440396795	0.144783476	0.096592466	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in employment in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix I1 – Output Elasticity Australia 1992

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.009722	0.00013	0.00093	0.000281	0.000129	0.000176	0.00018	7.23E-05	0.01162
Mining	0.000352	0.019114	0.001253	0.000503	0.000172	0.000205	0.000246	0.002219	0.024063
Manufacturing	0.026101	0.012041	0.11086	0.03137	0.012312	0.010796	0.016188	0.007259	0.226928
Construction	0.000232	0.000424	0.000132	0.044678	0.000193	0.000301	0.000976	0.000221	0.047157
Trade	0.003492	0.001789	0.00409	0.003048	0.051175	0.001972	0.00208	0.001002	0.068648
Services	0.043584	0.041187	0.046903	0.048455	0.064097	0.237557	0.06892	0.02692	0.577623
Public Admin. Defence	0.00021	8.9E-05	0.000222	0.000239	0.000193	0.000175	0.034438	0.000106	0.035671
Utility	0.000189	0.000315	0.000209	0.000109	8.83E-05	0.000213	0.000104	0.00706	0.008289
Backwards	0.083882	0.075089	0.164598	0.128683	0.12836	0.251395	0.123132	0.04486	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in output in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much output will be induced for that given sector.

Appendix I2 – Output Elasticity Australia 1996

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.011022	0.000153	0.001039	0.000328	0.000197	0.000165	0.000165	0.0001089	0.01318
Mining	0.000346	0.018471	0.001254	0.000562	0.000247	0.000191	0.000252	0.00213549	0.023458
Manufacturing	0.019884	0.012248	0.094264	0.026673	0.012572	0.008639	0.011894	0.008485209	0.19466
Construction	0.000214	0.000305	0.000117	0.041139	0.000204	0.000218	0.000808	0.000147083	0.043151
Trade	0.005803	0.002977	0.00517	0.004026	0.053911	0.00254	0.003766	0.003249786	0.081445
Services	0.045659	0.044569	0.058707	0.051563	0.09208	0.216587	0.059669	0.041519852	0.610354
Public Admin. Defence	0.000127	0.000186	0.000135	0.000104	0.000135	9.52E-05	0.025081	8.88752E-05	0.025952
Utility	0.000121	0.000193	0.000232	0.000101	0.000123	0.00012	0.000132	0.006781061	0.007801
Backwards	0.083175	0.079102	0.160918	0.124497	0.159469	0.228556	0.101767	0.062516256	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in output in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much output will be induced for that given sector.

Appendix I3 – Output Elasticity Australia 2001

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.008883607	0.00011	0.000699	0.000218	0.000304	9.90076E-05	0.000146	8.6109E-05	0.010545
Mining	0.000122802	0.016108	0.000584	0.000236	0.000304	8.48029E-05	0.000138	0.000715055	0.018291
Manufacturing	0.012101518	0.010266	0.075276	0.021185	0.026753	0.005969006	0.013129	0.007777262	0.172457
Construction	0.000788397	0.001414	0.00087	0.046029	0.002988	0.000990361	0.00362	0.003004703	0.059704
Trade	0.004611409	0.004077	0.00602	0.004819	0.059947	0.002544628	0.003206	0.003348405	0.088573
Services	0.032212083	0.04659	0.051078	0.063706	0.124417	0.199348793	0.051222	0.051762742	0.620336
Public Admin. Defence	6.7736E-05	0.000131	0.000134	0.000186	0.000365	0.000147565	0.022241	0.000109401	0.023381
Utility	0.000114467	0.000113	0.000177	0.000181	0.000289	8.07178E-05	0.000131	0.005625618	0.006713
Backwards	0.058902019	0.078809	0.134836	0.136559	0.215367	0.209264882	0.093832	0.072429296	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in output in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much output will be induced for that given sector.

Appendix I4 – Output Elasticity Australia 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.006272	7.66729E-05	0.000568	0.000162	0.00013	9.26737E-05	7.15387E-05	5.09829E-05	0.007423
Mining	0.000257	0.025680433	0.001161	0.000459	0.000379	0.000191948	0.000205948	0.001664575	0.029999
Manufacturing	0.010931	0.007701523	0.069127	0.016593	0.007749	0.006589324	0.006560449	0.005031685	0.130283
Construction	0.00164	0.004221183	0.001228	0.068134	0.001786	0.001411879	0.002656614	0.000976613	0.082055
Trade	0.005296	0.002855477	0.005459	0.004777	0.059622	0.003348977	0.00268949	0.002200448	0.086248
Services	0.048383	0.040686313	0.052925	0.080971	0.079107	0.2267379	0.06081645	0.039389549	0.629017
Public Admin. Defence	9.13E-05	0.000107506	0.000157	0.000158	0.000143	0.000233382	0.025751137	0.000140756	0.026782
Utility	0.00013	0.000147441	0.000192	0.000189	0.000101	0.000113704	0.000128936	0.007191406	0.008193
Backwards	0.073	0.081476547	0.130817	0.171444	0.149016	0.238719788	0.098880563	0.056646016	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in output in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much output will be induced for that given sector.

Appendix I5 – Output Elasticity Australia 2012

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	
Agriculture	0.009005	9.56712E-05	0.000794	0.000199	0.000145	8.43479E-05	6.40216E-05	4.00543E-05	0.010428
Mining	0.000556	0.0389974	0.002292	0.001132	0.000576	0.000381322	0.000343127	0.001484795	0.045763
Manufacturing	0.006139	0.004019115	0.050099	0.010807	0.003607	0.002808909	0.002818846	0.001782954	0.082082
Construction	0.002648	0.004547883	0.001778	0.081135	0.00237	0.002258951	0.003867556	0.000899928	0.099506
Trade	0.003126	0.002121433	0.003587	0.003278	0.042251	0.002485483	0.001731958	0.001239797	0.059821
Services	0.043522	0.058340124	0.052031	0.069324	0.077589	0.249906733	0.059707313	0.04919686	0.659617
Public Admin. Defence	0.000121	0.000259685	0.000212	0.00038	0.000224	0.00027907	0.0297959	0.000128443	0.031401
Utility	0.00022	0.000305278	0.000344	0.000211	0.000215	0.000188153	0.000254396	0.009646255	0.011384
Backwards	0.065336	0.10868659	0.111137	0.166466	0.126978	0.258392968	0.098583118	0.064419085	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in output in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much output will be induced for that given sector.

Appendix J – Output Multiplier Germany 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	1.143316	0.0790388	0.102598	0.0807	0.067914	0.073834	0.089039	0.067294	1.703735
Mining	0.019545	1.0767688	0.010067	0.011461	0.010138	0.0104863	0.012823	0.025658	1.176947
Manufacturing	1.630872	1.6322373	2.692164	1.872653	1.360207	1.4790893	1.544026	1.429387	13.64064
Construction	0.233347	0.2595305	0.223668	1.312032	0.233192	0.271663	0.303258	0.252672	3.089362
Trade	0.57281	0.5240858	0.629909	0.587441	1.459614	0.4287509	0.487814	0.463689	5.154114
Services	4.979827	5.1116579	4.804475	5.0983	5.219297	6.503868	5.421573	4.644084	41.78308
Public Admin. Defence	0.096188	0.1288141	0.09434	0.100713	0.08973	0.0965358	1.154657	0.199352	1.960329
Utility	0.387101	0.5044408	0.375825	0.357678	0.346691	0.3596358	0.379128	1.741693	4.452193
Backwards	9.063005	9.3165741	8.933047	9.420978	8.786783	9.2238632	9.392318	8.823829	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix K – Output Multiplier Sweden 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	1.377683	0.11991	0.166916	0.124441429	0.098894	0.108863205	0.111537	0.110198	2.218443
Mining	0.022542	1.129945	0.015666	0.015601214	0.01556	0.016162538	0.022649	0.076381	1.314507
Manufacturing	1.284611	1.417953	2.448091	1.596997953	1.179501	1.248685487	1.327545	1.336386	11.83977
Construction	0.250008	0.293373	0.235448	1.248356352	0.257906	0.278692753	0.335311	0.337227	3.236323
Trade	0.49101	0.533282	0.475284	0.442248428	1.342131	0.308917501	0.36596	0.394078	4.352911
Services	3.089651	4.01605	3.545457	3.770733539	3.940555	4.909896369	4.080333	3.602746	30.95542
Public Admin. Defence	0.141729	0.176836	0.160012	0.163044338	0.175602	0.187163871	1.203108	0.181893	2.389388
Utility	0.182995	0.275392	0.199364	0.184806217	0.195391	0.193767474	0.217614	1.371451	2.820782
Backwards	6.84023	7.962741	7.246239	7.546229471	7.20554	7.252149198	7.664058	7.41036	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total output induced in the economy by $1 worth of output from that particular sector. Each sector within the column informs you how much output will be induced for that given sector.

Appendix L – Output Elasticity Germany 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public	Utility	Forwards

							Admin. Defence		
Agriculture	0.000451	3.1187E-05	4.04832E-05	3.18427E-05	2.67973E-05	2.91333E-05	3.5133E-05	2.65528E-05	0.000672
Mining	2.23E-06	0.00012275	1.14765E-06	1.30653E-06	1.1558E-06	1.19546E-06	1.4619E-06	2.92501E-06	0.000134
Manufacturing	0.034015	0.0340433	0.05615003	0.039057619	0.028369618	0.030849122	0.0322035	0.029812492	0.284501
Construction	0.000645	0.00071694	0.000617872	0.003624421	0.000644181	0.000750455	0.00083773	0.000697995	0.008534
Trade	0.002417	0.00221148	0.002658018	0.002478815	0.006159111	0.001809194	0.00205842	0.001956623	0.021749
Services	0.080425	0.08255436	0.07759329	0.082338628	0.084292747	0.105038849	0.08755955	0.075002945	0.674806
Public Admin. Defence	0.000267	0.00035753	0.000261848	0.000279536	0.000249051	0.000267942	0.00320483	0.000553315	0.005441
Utility	0.000362	0.00047173	0.000351451	0.000334481	0.000324207	0.000336311	0.00035454	0.001628735	0.004163
Backwards	0.118584	0.12050928	0.137674139	0.128146649	0.120066867	0.139082203	0.12625517	0.109681582	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in output in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much output will be induced for that given sector.

Appendix M – Output Elasticity Sweden 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.000602	5.24319E-05	7.29857E-05	5.44133E-05	4.32425E-05	4.76015E-05	4.87707E-05	4.81851E-05	0.00097

Mining	4.62E-06	0.00023171	3.21261E-06	3.19923E-06	3.19077E-06	3.31434E-06	4.6445E-06	1.56629E-05	0.00027
Manufacturing	0.026724	0.0294975	0.05092734	0.033222155	0.024537016	0.025976253	0.027616765	0.02780068	0.246301
Construction	0.000857	0.001005867	0.000807264	0.004280146	0.000884262	0.000955533	0.001149656	0.001156225	0.011096
Trade	0.003047	0.003309617	0.002949673	0.002744653	0.008329445	0.001917183	0.002271197	0.002445701	0.027015
Services	0.070341	0.091432074	0.080718243	0.085847038	0.089713311	0.111781979	0.092895588	0.08202252	0.704752
Public Admin. Defence	0.000425	0.000530296	0.000479844	0.000488937	0.000526594	0.000561266	0.003607874	0.00054546	0.007165
Utility	0.000158	0.000237348	0.000171823	0.000159276	0.000168399	0.000166999	0.000187552	0.001181991	0.002431
Backwards	0.102159	0.126296843	0.136130386	0.126799817	0.12420546	0.14141013	0.127782047	0.115216424	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in output in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much output will be induced for that given sector.

Appendix N – Employment Multiplier Germany 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	13.77808519	0.952495	1.236413	0.97252	0.818428	0.889772	1.073011	0.81096	20.53169
Mining	0.111302455	6.131825	0.057328	0.065264	0.057735	0.059716	0.073024	0.14611	6.702305

Manufacturing	5.961996083	5.966986	9.841773	6.845877	4.972523	5.407122	5.644512	5.22542	49.86621
Construction	2.08050756	2.313963	1.994215	11.69802	2.079129	2.422136	2.703836	2.25282	27.54462
Trade	5.826255038	5.33066	6.407025	5.975065	14.84624	4.360976	4.96173	4.71635	52.4243
Services	37.99702676	39.00293	36.65906	38.901	39.82423	49.62575	41.36763	35.43525	318.8129
Public Admin. Defence	0.980335858	1.312862	0.961506	1.026456	0.914518	0.983884	11.76816	2.03177	19.97949
Utility	0.779468333	1.015745	0.756764	0.720223	0.6981	0.724165	0.763414	3.50708	8.964961
Backwards	67.51497727	62.02746	57.91408	66.20443	64.2109	64.47352	68.35532	54.12576	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix O – Employment Multiplier Sweden 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	3.975066891	0.34598	0.481607	0.359054	0.285342	0.314106	0.321821	0.31796	6.400934
Mining	0.049663918	2.48947	0.034516	0.034372	0.034281	0.035609	0.0499	0.16828	2.896093
Manufacturing	3.204708842	3.537354	6.107231	3.984017	2.942491	3.115085	3.311816	3.33387	29.53657

Construction	1.26238288	1.481349	1.188864	6.303404	1.302259	1.407221	1.693107	1.70278	16.34137
Trade	2.918270606	3.169505	2.8248	2.628459	7.976821	1.83602	2.175047	2.34216	25.87109
Services	17.819106	23.16197	20.4479	21.74715	22.72657	28.3171	23.53272	20.77831	178.5308
Public Admin. Defence	0.940189497	1.173083	1.061478	1.081591	1.164893	1.241594	7.981085	1.20663	15.85054
Utility	0.419107416	0.630722	0.456598	0.423256	0.447499	0.44378	0.498395	3.14099	6.460348
Backwards	30.58849605	35.98944	32.60299	36.5613	36.88016	36.71052	39.56389	32.99098	

Interpretation: These are type II multipliers or simple multipliers. Each total backward linkage (column) is the total employment in the economy induced by $1 Million worth of output from that particular sector. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix P – Employment Elasticity Germany 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.010969698	0.000219	0.052034	0.005421	0.006968	0.028995	0.006009	0.00153	0.112147
Mining	8.86157E-05	0.001411	0.002413	0.000364	0.000492	0.001946	0.000409	0.000276	0.007398
Manufacturing	0.004746762	0.001373	0.414185	0.038159	0.042338	0.176204	0.031612	0.00986	0.718477
Construction	0.001656438	0.000532	0.083925	0.065205	0.017702	0.078931	0.015143	0.004251	0.267346

Trade	0.004638689	0.001226	0.269636	0.033305	0.126406	0.142113	0.027788	0.008899	0.614012
Services	0.030252092	0.008972	1.542773	0.216834	0.339078	1.617177	0.231678	0.066863	4.053628
Public Admin. Defence	0.000780514	0.000302	0.040464	0.005721	0.007787	0.032062	0.065907	0.003834	0.156858
Utility	0.000620589	0.000234	0.031848	0.004015	0.005944	0.023599	0.004275	0.006618	0.077152
Backwards	0.053753398	0.014268	2.437277	0.369023	0.546715	2.101029	0.382822	0.10213	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in employment in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much employment will be induced for that given sector.

Appendix Q – Employment Elasticity Sweden 2007

	Agriculture	Mining	Manufacturing	Construction	Trade	Services	Public Admin. Defence	Utility	Forwards
Agriculture	0.004162059	0.00017	0.023991	0.002948	0.00424	0.017124	0.002311	0.000656	0.055602
Mining	5.20002E-05	0.001222	0.001719	0.000282	0.000509	0.001941	0.000358	0.000347	0.006432
Manufacturing	0.003355462	0.001737	0.304223	0.032709	0.043728	0.169822	0.023781	0.00688	0.586235

Construction	0.001321767	0.000727	0.059222	0.051751	0.019353	0.076716	0.012158	0.003514	0.224762
Trade	0.00305555	0.001556	0.140713	0.02158	0.118543	0.100092	0.015619	0.004834	0.405992
Services	0.018657338	0.011373	1.018582	0.178544	0.337737	1.543733	0.168983	0.042881	3.320491
Public Admin. Defence	0.000984417	0.000576	0.052876	0.00888	0.017311	0.067687	0.05731	0.00249	0.208115
Utility	0.000438823	0.00031	0.022745	0.003475	0.00665	0.024193	0.003579	0.006482	0.067873
Backwards	0.032027415	0.017672	1.62407	0.300169	0.548072	2.001307	0.284099	0.068085	

Interpretation: These are elasticity coefficients derived from simple multipliers. Each total backward linkage (column) is the total change percentage change in employment in the total economy induced by a 1% change in final demand of that section. Each sector within the column informs you how much employment will be induced for that given sector.