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cutting through complexity

Economic Impact Assessment

Tasmanian Aquaculture Industry

Tasmanian Salmonid Growers Association

May 2015

kpmg.com.au

Tasmanian Salmonid Growers Association

PO Box 321

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28 May 2015

Dear Adam,

Economic Impact Assessment: Tasmanian Aquaculture Industry

KPMG, in association with Professor John Mangan from the University of Queensland, is pleased to provide our study into the current economic contribution of the salmonid (Atlantic salmon and Ocean trout) aquaculture industry to the Tasmanian economy.

In summary, our analysis has found that in terms of state wide economic impacts, the industry in Tasmania currently generates the following results *per annum*:

- average annual Turnover or Gross Output of $1.12 billion (the total value of industry production)
- annual Value added or net additions to Gross State Product (GSP) of $625.9 million (the added value of industry production, equivalent to the GSP definition, as used by the Australian Bureau of Statistics)
- annual gain to factor income of $366.8 million (income paid to individuals and firms), and
- support for approximately 2,786 FTE jobs (full time positions employed in, or supported by the industry).

The report also includes analysis of the economic significance of the industry's leakage effect on the rest of the Australian economy. The results highlight the importance of the industry to Tasmania and the rest of Australia.

Yours sincerely,

David Richardson

Director

Executive summary

KPMG, in association with Professor John Mangan from the University of Queensland is pleased to provide this report, which examines the current economic contribution of the Tasmanian salmonid (Atlantic salmon and Ocean trout) aquaculture industry to the Tasmanian economy and the economic significance of its leakage effect on the rest of the Australian economy. Key points to note are as follows:

- To undertake the analysis the combined economic operations of TSGA, Saltas, Huon, Petuna, Van Diemen and Tassal were considered in aggregate, averaged over the period 2013/14.
- To estimate the total economic impacts of the operations in Tasmania, the combined expenditure (cost) data from these companies were applied to the Tasmanian Non-Linear Model.
- This model was developed from an original table supplied by KPMG and modified to have marginal coefficient properties by the IOW methodology developed at the University of Queensland.
- It is believed that this form of modelling is superior to traditional forms of Input/output modelling and the most suitable form of economic model for this task.
- In the absence of a separate Aquaculture sector (not provided in sufficient detail by the ABS for Tasmania) the coefficients from the Agricultural, Forestry and Fishing sector were modified to more closely fit the expenditure patterns detected in the aquaculture industry and used to mirror the structure of the industry in Tasmania.
- In view of the leakage of activity to the rest of Australia a separate estimate of "Rest of Australia" impacts was also estimated.
- It was found that the Tasmanian industry is part of a world-wide aquaculture industry that is expanding and is believed to have significant production and commercial advantages in comparison to wild- fisheries.
- By 2030, Aquaculture is anticipated to hold over 60% of the world fish market.
- It was found that given sufficient capitalisation, the Tasmanian industry has substantial opportunities to expand exports.

In terms of state-wide economic impacts, the following results were generated:

- an average annual Turnover or Gross Output of $1.12 billion
- an annual Value added or net additions to GSP of $625.9 million
- an annual gain to factor income of $366.8 million, and
- support for approximately 2,786 FTE jobs.

This represents, in terms of the contemporary Tasmanian economy, 2.3% of State GSP, and 1.2 % of State employment.

In addition, the operations of these companies contribute to the rest of the Australian economy, annually to the tune of:

- an average annual Turnover or Gross Output gain of $180.9 million throughout the rest of Australia
- an annual Value added to GSP of $115.2 million
- an annual gain factor income of $69.1 million, and
- support for approximately 417 FTE jobs

Appendix 1 provides a summation of the current state of the Tasmanian economy, prepared by Professor Mangan, which highlights the rise in importance of fresh food exports and the potential for aquaculture to add to this.

Contents

1. Introduction

Purpose

This report examines the current economic contribution of the Tasmanian salmonid (Atlantic salmon and Ocean trout) aquaculture industry to the Tasmanian economy and its leakage effect on the rest of the Australian economy. This study is driven by Senate Committee inquiry into the regulation of the fin-fish industry in Tasmania, which has been established with the following Terms of Reference:

a. the adequacy and availability of data on waterway health;
b. the impact on waterway health, including to threatened and endangered species;
c. the adequacy of current environmental planning and regulatory mechanisms;
d. the interaction of state and federal laws and regulation;
e. the economic impacts and employment profile of the industry; and
f. any other relevant matters.

Scope and approach

The purpose of the study is to provide the TSGA with estimates of the economic impact/ benefits of the salmon industry to Tasmania. This estimates the impacts of the entire vertically integrated industry, and in so doing, contributes to the TSGA's submission in response to item (e) of the Senate Committee inquiry. (**Scope**). The project has proceeded in steps as outlined below.

Step 1: Research, data collection and analysis	• Develop a data collection template and pre-populate that with any available data, as far as practicable in relation to: - Operational expenditure – salaries and wages, other key operating costs etc. - Capital expenditure – maintainable/ indicative capital expenditure in a given year - Direct employment – full time equivalent positions employed by entities in the industry • Distribute the template to the four key industry operators and any other related operations that expend/ invest in the industry – SALTAS and TSGA, and invite those entities to populate the template (i.e. estimate local versus off-shore expenditure) and validate the assumptions • Collate and review the data supplied, to ensure it was complete and reasonable
Step 2: Economic impact model	• Use data from step 1 to derive the flow-on or multiplied economic benefits of the industry sector, as outlined in the definitions below • Professor John Mangan from the University of Queensland has undertaken this component of the project using the Tasmanian Non-Linear Model. The TNLM is outlined in further detail in Appendix 2.
Step 3: Final report	• Compile the outcomes of the preceding steps into a draft report for initial consideration by you. • Resolve any issues in relation to the draft and finalise the report.

Important definitions

The key outputs generated by the analysis are defined as follows:

- ***Gross Output (regional turnover) –*** this refers to the gross value of increased production from an additional economic activity. Within this gross value is included the value of raw materials that, in most cases, have already been counted as part of gross output from earlier production. Therefore there is a tendency for *Gross output figures to include some double counting.* As a result, more concentration is placed upon incremental (additional output created) *or value added.* Nevertheless, the concept of Gross output should not be abandoned because it is a good indicator of the level of turnover in the economy and hence a good measure of the total level of economic activity.
- ***Value Added -*** refers to added or net output. Value Added is equivalent to the Gross State / Regional Product as used by the Australian Bureau of Statistics. **It is the measure usually preferred when measuring economic impact**. It measures the added value placed on intermediate products (raw materials) from the productive process. It is made up of margins, wages, profits and transfers.
- ***Factor Income -*** relates to the share of value added (and gross output) which is paid to individuals or firms, both directly and indirectly in the form of wages and or profits. By definition it is a percentage of value added and cannot exceed value added.
- ***Jobs -*** relates (usually) to the amount of labour required for the level of production. Depending upon the type of activity, job numbers measure either the use of existing labour (continuing jobs) or hiring new staff. Full Time Equivalent (FTEs) employment refers to the number of full time person-years of employment generated by a particular project or event. This alleviates the overstating of the level of job growth due to the stimulus.

The 'headline' results most commonly reported focus on value added (i.e. the added value of industry production or Gross State Product) and jobs (i.e. full time positions employed in, or supported by the industry).

Report structure

This report sets the context for the results of the economic impact analysis by outlining the scale and scope of the global/ Australian aquaculture industry and the findings from other similar studies into the economic impact of the aquaculture industry **(Chapter 2)**. The findings of the economic impact modelling of the aquaculture industry in Tasmania are detailed in **Chapter 3**.

The appendices, prepared by Professor Mangan, include a summation of the current state of the Tasmanian economy, which highlights the rise in importance of fresh food exports and the potential for aquaculture to add to this **(Appendix 1)** and a detailed explanation of the Tasmanian Non-Linear Model **(Appendix 2).**

2. The Aquaculture industry

The global outlook

In a constrained world market for seafood and protein in general, Aquaculture has been identified as the world's fastest developing source of animal protein, growing by more than 60 percent over the past decade.

The Food and Agriculture Division of the United Nations (FAO) report that fish now accounts for 17 per cent of global protein consumption. Current world fish production is currently valued at $138 billion (Australian) and the FAO predicts that aquaculture will account for 62 per cent of fish consumed in the world by 2030. The drivers of this growth include the sharp rise in consumer demand for fish, and the levelling off of catches from wild fisheries, which saw the proportion of the total fish catch contributed by wild fisheries decline from 90% in the 1970's to 70.2% currently.

In contrast, over the same period, aquaculture has grown world-wide to produce 66.6 million tonnes of edible fish annually, from a low base of 1.6 million tonnes. Tasmania, with an already establish reputation as an exporter of high value added food represents the natural place in Australia to consolidate and expand the industry. The State has a number of clear advantages in sustaining a growing aquaculture industry including;

- adequate waterway resources
- established reputation for high quality in the export of fresh food
- recognised leadership in food safety standards'
- disease free reputation
- well- developed food trade routes

Moreover, projected world demand for aquaculture products makes expansion of the industry in Tasmania a relatively low risk enterprise. Malpass (2014) claims that aquaculture is "the most exciting agricultural industry because of the proliferation of new species, growing areas and technologies. Recent studies by Business Review Weekly support this view, claiming that the industry in Australia has the potential for rapid growth over the next 3-5 years provided it can overcome its' significant undercapitalisation.

If this can be achieved, Tasmanian Atlantic salmon represents a higher-value/premium product for both domestic and export markets: Not all participants in the fishing industry see the rapid growth in aquaculture as desirable. Issues such as the use of ingredients derived from wild fisheries (fishmeal and fish oil) in salmonid feeds have generated considerable debate, particularly in Canada. However, Salker et. al. (2007) find that "production efficiency of farmed salmonids has significantly improved over time due to continued innovations in the aqua-feed sector. The results suggest that the Canadian salmon aquaculture industry efficiently converts wild fish resources into high-value fish production" (Salker, et. al p. 3).

Eagle, Naylor and Smith (2003) argue that farm salmon fishing out-competes wild fisheries in an economic and commercial sense. They list a number of technological and economic factors benefitting aquaculture as well as a number of structural issues in the fishing industries which have limited the ability of wild fisheries to adapt to a changing world market. Even critics of the industry have acknowledged that "proprietary fish production has grown at a rate twice as fast as a wild salmon, leading to greater 'efficiency' in terms of reduced costs and reduced time to market. (Clausen and Longo, 2012)

Tasmanian Atlantic salmon is a comparatively higher value/premium quality product in which Tasmania has distinct advantages when it comes to growing, processing and selling salmon to domestic and export markets. Perhaps more importantly, the industry and its likely expansion is providing a valuable addition to a sluggish Tasmanian economy.

Aquaculture in Australia

The Aquaculture industry in Australia has grown strongly over the last 5 years, at an average rate of 5% per annum, despite significant reduction in production in 2013/14 due to a disease outbreak in fish stocks. IBISWorld (2015) economic profile of the industry predicts industry revenue will grow by 7.7% in 2014/15. The main aggregates of the industry in Australia are set out in table below. The data in table (1) indicates an

industry characterised by low levels of concentration, with the two largest producers, the Tassal Group and Huon Aquaculture controlling about 31% of the market and the remaining production being spread across a large number of producers.

Table (1): Key Statistics - Aquaculture in Australia

Revenue	$1.2 billion
Annual sales growth 2010-15	5.0%
Predicted sales growth 2015-20	3.0%
Net Profit (2014/15)	$140.9 m
Number of establishments	1445
Export revenue	$379.3 m
Percentage of output exported	3.1%
Largest market share	Tassal group 16.5% of market
Second largest market share	Huon Aquaculture 13.9% of market

Source: IBISWorld Industry report Ao2000; Aquaculture in Australia, April 2015

The same forces that have driven growth in the industry world-wide are at play in Australia, but in recent years the relatively high Australian dollar has limited export penetration. Consequently, the level of export penetration is low and suggests considerable room for expansion in growing world markets, particularly as the value of the Australian dollar has declined almost 30% from a high in 2010.

IBISWorld (2015) have also made a number of observations about the current industry structure. They observe that the industry in Australia is currently in the growth stage of its life cycle and predict earnings to grow to $1.5 billion by 2020-1, with an average revenue growth of 3% per annum over that period. Revenue volatility is considered likely to be moderate, especially in comparison to other agricultural activities, but the industry is characterised by high levels of technological change and firms within the industry face high levels of competition. One constraint on the growth of the industry is the current high levels of regulation, principally on the environmental side and low levels of Government assistance, particularly in regards to other industries in the Agriculture, Forestry and Fishing Industry.

According to IBISWorld (2015) "the industry is anticipated to expand over the next 5 years as seafood consumption increases and environmental policies are implemented to ensure the replenishment of fish stocks."(p.2) Exports, especially to Asia are expected to grow but domestic market growth may be constrained by rising domestic fuel prices and wage costs.

Other studies of the economic impacts of Aquaculture and Salmon farming

A number of studies into the total economic impacts of aquaculture have undertaken across countries at various stages of economic development. This review will concentrate on studies undertaken in economies similar to Australia and Tasmania. The studies of major interest are highlighted in table (2).

The Fish Research Development Council (FRDC) examined a number of subprograms pertaining to the salmon aquaculture in Tasmania. They estimated investment benefit/cost ratios which they estimated from a high range of 8:1 to a low range of 5:1. Even at the low range this ratio is high and well above the social return ratios used to justify public spending . Overall they estimated internal rates of return to salmon aquaculture from 23.4% to 18.1% and a net present value of investment return at $ 78 million.

The research firm, Econsearch (2012) examined the fishing industry in South Australia, including aquaculture. They found that aquaculture contributed 52% of revenue to the industry in South Australia and that this proportionate contribution was growing. In terms of the overall impact of aquaculture on the South Australian economy, they estimated that the direct contribution for 2011/12 was $229 million with the total impact being expanded by output multipliers of 1.85, value added multipliers of 2.19, income multipliers of 4.55 and employment multipliers of 3.43.

Table (2): Impact Studies of farm and non-farm salmon fishing

Name of Study	Author (s)	Country/ Region	Method(s)	Main findings
An economic evaluation of [1]FRDC Investment in Salmon aquaculture sub-program	Fish Research Development Council (FRDC)	Tasmania	Internal rate of return (IRR) on capital and the benefit/cost ratio	Benefit/cost ratio; 8:1 (high) 5:1 (low); IRR from 18.2% to 23.4%. Overall, a net present value estimated at $78 m and a benefit-cost ratio of 7 to 1 (using a discount rate of 5%, with benefits measured over 30 years from the final year of investment).
Economic Impacts of salmon and steelhead fish farming in the Idaho river (non-farm)	J. 0'Laughlin[2]	Idaho (USA)	Input –output analysis	Findings: Generation of US$544 M (2005) Output multipliers ranging from 1.60 to 1.77, slightly lower than Aquaculture multipliers.
The Economic Impact of Aquaculture on the South Australian State and Regional[3]	Econsearch (2012)	South Australia (Eyre Peninsula)	Input/output analysis (by fish or crustacean type)	Aquaculture contributes 52%total fish revenue; $229 M in 2011.12. For Tuna Econsearch estimated output 2a multiplier of 1.85; Value added multiplier, 2.19. Household income multiplier 4.55; employment multiplier 3.43
Economic Impact Study of Commercial Fishing in Western Australia	McLeod & McGinley (1998)	Western Australia (various types)	Input/output analysis	Value of industry increased 18% from 2009/10 to 2010/11 to $228.64 M. For Salmon farming output multiplier; 1.79-2.59; income multiplier, 1.72-2.52; employment multiplier 3.04
The Economic Importance of the Bristol Bay Salmon Industry	http://fishermenforbristolbay.org/	Bristol Bay, Canada	Input/output analysis	Output 2A multiplier 1.54; Value added 1.91; Income multiplier 1.86, no employment estimates recorded
The Economics Impact of the Fisheries and Aquaculture industry in Norway: A multiplier Effect Study	Sander, et.al https://www.was.org/doc	Norway	Input/output and other analysis	Major growth area, Value added multiplier 1.92; employment multiplier 1.93
The Economics of the Norwegian Salmon Fishing Industry			Review for 25 years of economic study	Industry on long term growth path but very sensitive to fluctuations in inputs(oil and power) and the price of wild fisheries salmon

[1] FRDC (2010) " An Economic Analysis of FRDC Investment in Salmon Aquaculture Program (Cluster, 7)

[2] O'Laughlin, J (2005) :The Economic Impact of Salmon and Steelhead Fishing in the Idaho River" Review of Fisheries Report" no.6

[3] Note this study highlighted tuna farming rather than salmon

The other listed studies for Norway and Canada all report similar levels of economic significance for aquaculture, with output multipliers ranging from 1.54- 2.59 range. There seems to be more agreement on the value adding strength of the industry; most estimates in the 1.9 to 2.2 range. As noted, Econsearch also report a high income multiplier.

3. Economic Impact Assessment

Approach

Economic impact assessment aims to explain how one industry sector (or a project or activity within that sector) affects other sectors in the economy.

The economic modelling undertaken in this report makes use of a specifically constructed non-linear (marginal coefficients) Input-Output table for Tasmania within the Tasmanian Non-Linear Model. In the case of evaluating the economic significance of the salmon aquaculture industry the TNLM has the distinct advantage by allowing for the generation of non-proportional or non-linear results. That is, it allows us to investigate economic impacts that are expected to differ in magnitude and importance across time as the industry expands and shifts towards greater emphasis on exports (rather than remain constant). This is well suited to this purpose.

The approach used builds upon this established methodology by using a purpose-built non-linear or "marginal coefficients" adaptation to Input-Output modelling to investigate the impact of aquaculture in Tasmania. The advantages of this type of method are outlined more fully in the appendix to this report, but primarily, this technique removes some of the well-known problems of traditional Input-Output modelling, whilst maintaining the flexibility and relative data parsimony that have made Input-Output analysis such a popular and continuing method of economic analysis.

Sources of value from economic activity

Economic models are driven by what is called 'shifts in final demand'. By this it is meant that new expenditure on finished products represents a stimulus to economic activity. If this new expenditure is exogenous (i.e. originates from outside the economy it is spent in), it is particularly valuable to the local economy because it represents additional new investment, not just displacement from other areas of past spending within that economy.

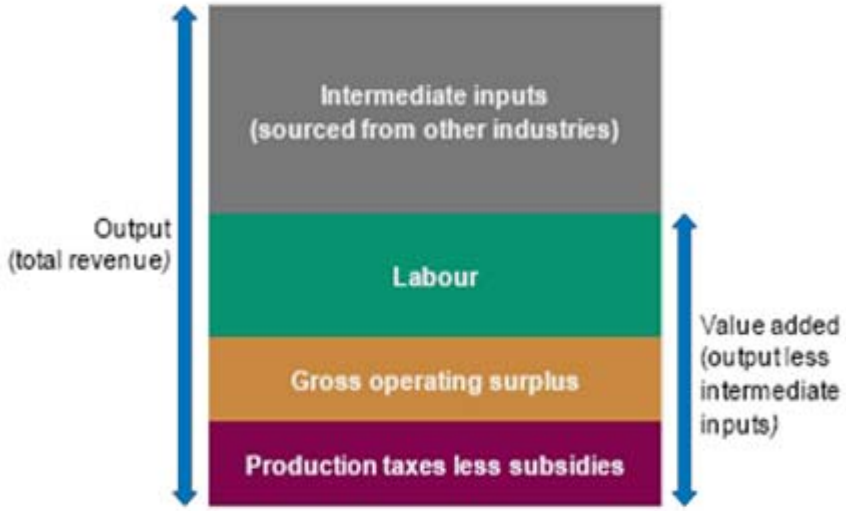
Inward tourist spending is a good example of this type of exogenous investment. This initial amount of exogenous expenditure on final demand products is often increased or "multiplied" to provide an estimate of the total impact on the economy, because demand for final demand products also requires a boost in demand for intermediate products used in their production. The higher the percentage of intermediate goods the higher is this multiplied effect.

This multiplied effect often shows up in significantly expanded Gross Output/Regional Turnover. However, this data is often partially discounted due to concerns over possible double-counting during the estimation process. However, Gross output or Turnover effects remain a legitimate source of economic knowledge, particularly in terms of defining the capacity of an economy to undertake large projects.

In contrast, the economic value of a particular activity to an economy is often measured through its value added or additions to Gross Regional Product (GRP) per Gross State Product (GSP). When the Government says the Tasmanian Economy grew by 3% per annum they mean that the GSP of Tasmania increased by 3%[4], where GSP is the increment added to the sum of the value of intermediate products resulting from the sale of the final demand products.

This process is illustrated below. Value added is a sub-component of Gross Output, which in turn may be subdivided into its labour component (wages and other income such as dividends) and gross operating surplus, which includes company profits and production-generated taxes and charges

[4] Which suggests that turnover increased by 5%-6% but some of this was double counted



Modification of the Agricultural, Forestry and Fishing sector

There is currently no separate Aquaculture sector reported for the Tasmanian economy. The Australian Bureau of Statistics (ABS) does not provide state based output, value adding or employment components for this industry in Tasmania, preferring to include them within the overall data on the Agricultural, Forestry and Fishing sector.

For the purpose of this study, the expenditure patterns provided for the companies were used to modify the coefficients of the Agriculture, Forestry and Fishing sector (and the table re-balanced) to more closely reflect the unique conditions of the industry. However, no reliable data on industry linkages was available and so the default values for the parent industry were used.

The aquaculture industry in Tasmania is likely to be of high economic value because almost all of its expenditure is exogenous - that is, the expenditure would not be used for alternative purposes. It has broad links with the rest of the economy (especially the service and transport industries), which generates a high (multiplied) output or turnover effect and so expands the capacity and depth of an economy and has significant export potential.

Relationships between sectors within the economy

Backward and forward linkages

Economic impact analysis requires the identification and modelling of relationships between key sectors within the economy. This analysis is based on an Input-Output approach. Input-Output tables are often used to identify relationships between sectors within an economy through the use of backward and forward linkages. This analysis was first used by Rasmussen (1956) and Hirschman (1958) and has since been widely used.

A backward linkage measures the economic activity between one sector and those other sectors supplying inputs either directly to the sector in question, or indirectly by supplying inputs to another supplier. For example, an increase in output of exploration services will require additional inputs such as fuel and accommodation. A forward linkage measures the relative importance of the sector as a supplier to the other sectors in the economy.

Linkages are reported as an index value commencing at zero. A linkage greater than 1 is considered strong, a linkage greater than 0.5 is considered average and a linkage less than 0.5 is considered small.

There are two broad dimensions to 'backward' effects. Backward linkage examines the intensity or strength of the relationship between a sector and its suppliers and backward spread examines the coverage of

suppliers throughout the economy; for example how many of the other sectors form part of the supply chain. Forward relationships work in the same way but measure the strength and coverage of sales from a sector to other parts of the economy.

Analysis of Backward and Forward Linkages for the Agriculture, Forestry and Fishing Sector in Tasmania

Linkage indices have been used to identify key sectors of the economy. Key sectors are typically defined as industries that have both strong forward and backward linkages with other industries in the economy. Changes in the output of sectors with strong backward and forward linkages will have the greatest relative impact on the rest of the economy. Sectors that have strong forward linkages are affected to a greater extent by changes in the general level of local economic activity.

The Tasmanian marginal coefficients table was used to generate backward and forward linkages for the Agriculture, Forestry and Fishing sector in Tasmania.

Table (3): Backward and Forward Linkage and Spread - Tasmanian Agriculture, Forestry and Fishing

	Output	Value Added	Factor Income	Employment
Backward Linkage	1.09	1.20	1.35	1.89
Backward Spread	1.01	0.86	1.05	0.94
Forward Linkage	1.05	1.01	1.15	0.86
Forward Spread	0.92	0.87	0.96	0.84

Source: TNLM (2014)

Linkages are reported for four economic measures: output, value added, factor income and employment. The results for each category run down the column. For example, for Tasmania as a whole, the output linkages for Agriculture, Forestry and Fishing are fairly strong with a backward linkage of (1.09). Based on this is a backward spread (1.01), value added backward linkage (1.20), factor income linkage (1.35) and employment linkage (1.89) are above average (except for employment) forward linkages in value added, income and employment.

By way of comparison, the estimated output backward linkages and spreads for other sectors in the Tasmanian economy include:

- Mining (1.29)
- Manufacturing (1.39)
- Retail Trade (1.34)
- Transport, Postal and Warehousing (1.30)
- Electricity, Water and Gas (1.17)
- Education (1.08).

Comparison of the data suggests that the modified Agricultural, Forestry and Fishing sector is a lower to middle ranking contributor (in terms of linkage effects) in the Tasmania economy, lying somewhere in the middle of importance in terms of the other sectors.

Input data

To undertake the analysis the combined economic operations of TSGA, Saltas, Huon, Petuna, Van Diemen and Tassal were considered in aggregate. There are some possible downsides, in a modelling sense, to doing this, as the production functions of each company might have significant differences which prevent the accurate calculation of an aggregate production function. However, this was considered unlikely. Data

provided on joint expenditure over the years 2013, 2014 were averaged to provide an estimate of the annual level of operations of the combined group[5].

Table (4) sets out the expenditure items from the group, divided between local expenditure and external as well as the sectors used as impacting sectors in the TNLM.

Table (4): Consolidated data from industry participants

Expenditure item	Expenditure in Tasmania	Expenditure Externally	% External spending	Sector(S) assigned in models
Cost of sales (raw materials & consumables)	260,088,488	24,287,561	9.3	Proportioned across Retail and Wholesale Trade, Manufacturing, Transport EG&W and Construction[6]
Employee expenses	96,724,170	2,472,825	2.6	Treated as wages within Agriculture, Forestry and Fishing sector
Corporate overheads/admin expenses	14,655,542	3,129,253	21.4	Finance and Insurance Services/ Rental, Hiring and Real Estate services (1:1)
Marketing expenses	3,853,254	16,388,410	80.9	Information, Media and Technology
Distribution expenses	58,853,254	13,121,887	22.3	Transport, Postal and Warehousing; Administrative and Support services
Occupancy expenses	3,714,801	209,440	5.7	Rental, Hiring and Real Estate services
Research Expenses	3,917,961	0	0	Professional Scientific and Technical services
Other expenses	7,940,949	275,675	3.47	Other Services
Finance costs	11,032,007	2,157,219	19.6	Finance and Insurance Services
Taxes paid (benefit)	9,313,537	203,840	2.2	Public Administration and Safety
Property/Plant & Equipment	40,388,613	23,731,094	58.8	Wholesale Trade, Retail Trade, Manufacturing
Dividend paid	13,909,500	22,813	0.16	Treated as exogenous income and as an injection into Tasmanian economy (net of repatriations)

[5] With some allowance for inflation over the period.

[6] Using default values for operating expenses in aquaculture

Economic impact estimates

The data above were applied to the TNLM (local spending only) and the results are shown in table (5).

Table (5): Estimated total annual economic impact of combined Aquaculture group within Tasmania (including operations of TSGA)

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover ($m)	524.3	157.6	435.5	1117.4	593.1
GSP ($m)	263.6	79.2	283.1	625.9	362.3
Factor Income ($m)	119.0	34.2	213.6	366.8	247.9
Employment supported (FTEs)	1365	334	1089	2786	1421

Specifically, this suggests:

- an average annual Turnover or Gross Output of $1.17 billion
- an annual Value added or net additions to GSP of $625.9 million
- an annual gains to factor income of $366.8 million, and
- support for approximately 2,786 FTE jobs.

The most impacted sectors are Trade (Wholesale & Retail) (19% of total lost value added), Finance and Insurance (17%), Transport, Postal and Warehousing (13%) Public Administration and Safety (9%), Agriculture, Forestry and Fishing (5%), Manufacturing (5%) Information, Information, Media & Technology (3%) with the other 29% spread fairly evenly across the other sectors.

By way of interpretation, **industry effects** (sometimes called supplier effects) represent purchases from other sectors linked to the Agricultural, Forestry and Fishing. In the case of this sector there is a significant consumption effect, which is substantially larger than the industry effect. The consumption effect (sometimes referred to as the income effect) relates to the change in incomes and related spending as a result loss of the TT Line trade. The ratio of:

$$\frac{\text{Direct + Industry+ Consumption effects}}{\text{Direct effect}}$$

Yields the Type II multiplier[7], which is the most widely reported multiplier. Because of the strength of the consumption effect, Type II multipliers are the appropriate multipliers to be used when evaluating the employment impacts in this case.[8]

Table 5 shows that, of the $524.3 million, injected into the local economy (on average) over the 2013/14 period, an additional $157.6 million is generated through industry effects and $435.5 million through consumption effects leading to the total exogenous impact of $1.12 billion (approximately) per annum. The estimate for **consumption effects** is quite large and might be regarded as an over estimate. However, Econsearch (2012) estimated a very similar result for their study of aquaculture in South Australia.[9]

Similarly, the initial injection of $524.3 million generates $263.6 million in **value added** which in turn produces $79.2 million in industry effects, $283.1 million in consumption effects and a total of $625.9 million value added or additions to State GSP. Because of dangers in over counting associated with output and

[7] The Type I multiplier is the ratio of: Direct + Industry/Direct

[8] It can be seen from inspection of the results for the earlier studies listed in the report that the multiplier impacts generated for the industry in Tasmania are closely comparable with those found in other regions of Australia or overseas.

[9] Econsearch (2012) reported a household income multiplier of 4.55 compared to our estimate of 4.05. Bear in mind this only refers to the factor income component of value added

turnover estimates, the value added estimate is normally taken as the best measure of economic contribution although some argue that the turnover figure is a useful measure of economic activity[10].

In terms of **factor income** (mainly wages, profits and dividends), the initial value add injection of $263.6 million generates a $119.0 direct income effect, which then produces an additional $34.2 million in industry effects and $213.6 in consumption effects resulting in a total increase in factor income across the Tasmanian economy of $366.8 million. Estimating employment impacts is the most difficult task in economic estimation for several reasons. Firstly, jobs have different status; full time, part time and casual, each of which responds differently to economic stimulus.

To overcome this, all employment effects are measured in full time equivalent jobs. Secondly, actual jobs reported, may differ from the economically "efficient" number of jobs as suggested by a model such as TNLM. If the current level of jobs is "inefficient" the estimated job effect from economic activity may be less, as there is already some labour force underutilisation which will reduce the extent of more hiring or over time hours. Lastly, due to economies of scale, less jobs, proportionately, may be needed per increase in output. The marginal coefficients feature of the TNLM is intended to allow for this issue which is the root cause of why traditional IO models were seen to over-estimate employment effects.

In terms of the **employment** impacts here, from a base of 1365 direct jobs, an additional 1421 FTEs are generated throughout Tasmania from 334 FTEs from industry effects and 1089 FTEs from consumption effects.

In considering the current economic significance of the industry to the Tasmania economy, the TNLM uses whole-of state estimates (i.e. the values used to constrain the TNLM) for Gross State Product of $27.6 billion and employment of 239,000 persons. Seen in this context, the total contribution of the combined aquaculture firms to the Tasmania economy is 2.3% of State GSP and 1.2 % of State employment.

Impacts external to Tasmania

Inspection of the input data showed that the combined aquaculture group had significant activity interstate (rest of Australia). This could be regarded as leakage and not analysed. However, below we take the $86 million annual injection into the Rest of Australian economy and evaluate this using an aggregated Australian IO table[11].

This should provide useful information, but caution need be attached to the results as we have no data on where this expenditure took place (location), the sectors in the Australian economy linked to this activity or what sectors are directly impacted. As a result the same sectoral distribution used for Tasmania is used here to evaluate the rest of Australia effects[12]. The results appear below in table (6). As is normal, the multiplier effects are slightly higher for the National economy than the Tasmanian economy, except for employment.[13]

Table (6): Estimated annual economic impact of combined Aquaculture group external to Tasmania

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover ($m)	86.0	21.5	73.4	180.9	94.9
GSP ($m)	61.2	12.2	42.0	115.2	54.2
Factor Income ($m)	35.1	8.0	26.0	69.1	34.0
Employment supported (FTEs)	204	50	163	417	212

[10] Value added excludes the effect of double counting and so is regarded as the more appropriate 'headline' result to be reported

[11] Aggregated to the main sectors of primary, service, agriculture and manufacturing

[12] There is unlikely to be much difference.

[13] Direct employment data for the Rest of Australia activities are not available and had to be generated from default values.

Specifically, this analysis suggests:

- an average annual Turnover or Gross Output of $180.9 million throughout the rest of Australia
- an annual Value added to GSP of $115.2 million
- an annual factor income of $69.1 million
- support for approximately 417 FTE jobs

The main sectors effected were, primary sector (Agriculture, Forestry and Fishing), Manufacturing, Transport and services (Business and Finance) collectively accounting for 70% of value added.

Appendix 1: Tasmanian economy

Tasmania remains a small open economy heavily dependent on trade as a major source of income. To provide important context for this analysis and to place the significance of the Aquaculture industry in perspective, this section will examine: the recent performance of the Tasmanian economy, the structure of the Tasmanian economy and the potential value of the value of the aquaculture industry.

The Performance of the Tasmanian Economy

Gross State Product

The Gross State Product of Tasmania is currently around $27.6 Billion. Tasmania's natural resources have been its economic foundation for the past two centuries. Currently, it remains a small open economy heavily dependent on trade as a major source of income. The need to capitalise on the potential of the aquaculture industry comes at a time when for the Tasmanian economy as a whole, some of its industries, as well as its labour market, have not performed well either in an absolute sense and relative to the rest of the Australian economy. The table below lists the recent GSP performance of Tasmania and the Australian States.

Table (7): GSP for Australian States

	Annual Growth 2012-14 (%)	Average annual compound growth 2001-02 to 2012-14 (%)
New South Wales	1.8	2.1
Victoria	1.6	2.6
Queensland	3.6	4.0
South Australia	1.3	2.4
Western Australia	5.1	4.9
Tasmania	-0.6	1.8
Northern Territory	5.6	4.1
Australian Capital Territory	2.7	3.1
Australia	2.6	3.0

Source: ABS State Accounts (2014).Gross domestic product measured by chain volumes, ABS State Accounts.

It may be seen from the above data that Tasmania was the only state to achieve negative growth in GSP for the 2012-13 period (-0.6). Its average growth rate over the period 2001-02 to 2012-13 of 1.8% was the lowest of any State, well below the average of all Australian States (3.0%). The 2013-14 budget predictions suggest that 2014 will see a partial bounce back in the State's economy which is expected to grow by 2%, although this rate is still predicted to lag behind other states.

Labour force

Similarly, the labour market is expected to improve into 2014-15 but from a low base.

Table (8): Labour Force Aggregate: Australia and Tasmania September 2014

Indicator	Tasmania	Australia
Trend		
Level of employment ('000)	239.0	11,604.9
Monthly employment growth (%)	0.0	0.0
Unemployment rate (%)	7.2	6.0
Participation rate (%)	60.7	64.6

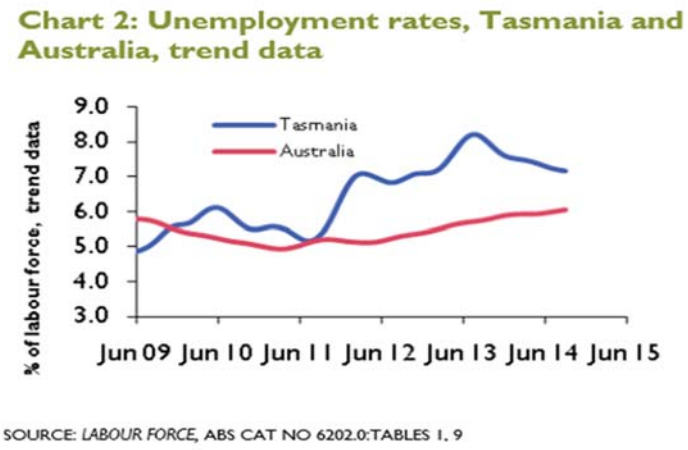
Indicator	Tasmania	Australia
Seasonally adjusted		
Level of employment ('000)	235.9	11,592.5
Monthly employment growth (%)	-0.6	-0.3
Unemployment rate (%)	7.4	6.1
Participation rate (%)	60.7	64.5

Source: Australian Bureau of Statistics (2014). Labour Force, ABS Catalogue 6202.0, Tables 1, 2 and 9

Employment levels in Tasmania have actually declined since 2012. The current level of Tasmanian employment is still below the level before the economic downturn in 2008-09. In comparison, national employment has been growing steadily since late 2009. Coinciding with the decline in the absolute numbers employed has been a strong shift to part-time employment in Tasmania, with the percentage of workers employed part time at 30.7% in September 2014.

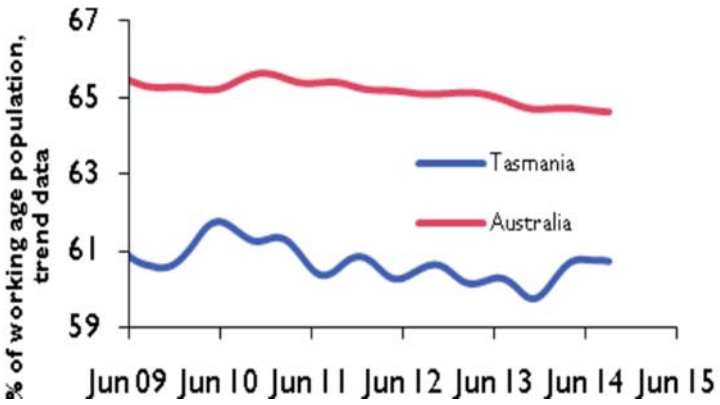
As a consequence of these changes in labour market status the number of total hours worked in Tasmania in 2013 was estimated by the ABS to be 4.6% below the level of one year earlier, compared to a national decrease of 1.9% in the same period. Unemployment at 7.4% is above the national average of 6.1%. The peak gap between the State and the national average (see Figure 1) occurred in June of 2013 and the two rates have begun to converge after that date.

Figure 1: Unemployment rates, Tasmania and Australia, trend data



Another distinguishing feature of the current Tasmanian Labour market is its relatively low rate of workforce participation, with an all–persons participation rate of approximately 61%, compared to 65.5% for the Australian economy as a whole.

Figure 2: All Persons Workforce Participation Rate – Australia and Tasmania



Implications

The reasons for Tasmania's sluggish economic performance are complex. The Tasmanian Treasury (2014) cites both cyclical and structural factors compounded by demographic issues involving a strong outward pattern of migration and the subsequent aging of the resident population. The cyclical elements relate to the fact that the Tasmanian economy is considered to be more sensitive to changes in external conditions and the value of the Australian dollar than the mainland states. This is exacerbated by the current industrial mix.

The State's sectors most affected by these cyclical forces are tourism, building and construction and retail. The Tasmanian Treasury reports that business and consumer confidence in Tasmania are currently at low levels, which has further contributed to weak private demand such as for dwelling investment. Former staples of the economy, such as Forestry and Manufacturing have continued to decline. The Tasmanian Budget papers (2014/15) report that the Forestry and Forest Products sector continues to face some major challenges despite the assistance granted under the Tasmanian Forests Agreement Bill 2012 and manufacturing has now shrunk to between 12% and 13% of total GSP, compared to 18% five years ago.

Part of the upside of structural change has been the growth in the service sector, much of it related to the growth in Agriculture and the provision of tourist-related services. The Tasmanian Government considers the prospects for some parts of Tasmania's agriculture industry continue to be strong boosted by strong Asian demand. Specific growth is expected to occur within Tasmania's dairy industry, aquaculture and some areas of high value manufacturing. Overall, in the last 12 months Tasmanian export volumes have been increasing.

The other piece of positive news is that public spending, although not expected to boost economic growth, will not have the contractionary effect that the cuts in public spending exerted on the economy in 2011 and 2012. The strong performance of Tasmania in the export of fresh food provides an ideal platform for an expansion of the salmon aquaculture industry.

In essence the issues relating to the Tasmanian economy are those which have faced it for over a decade, being:

- the long term structural change from traditional industries to service-related industries that have not fully compensated, particularly in employment
- an inadequate industrial mix that increases the sensitivity of the economy to external shocks; and
- demographic issues which reduce the potential of the labour force.

In addition the relatively low levels of productivity in Tasmania have been noted in a number of studies.

There are a number of possible explanations for Tasmania's lower levels of productivity, such as lack of economies of scale, human capital differences, issues relating to industry mix and lower participation rates. The factors that have influenced the Tasmanian economy are shared by most regional economies in Australia. These characteristics include:

- lower levels of human capital
- traditional industry structure impacted through structural adjustment
- ageing population
- isolated economies, and
- out-migration, particularly in the younger cohorts.

The Tasmanian Budget papers for 2014-15 make the following significant points regarding Tasmania's current economic position:

- household spending has returned to growth, driven in part by very strong growth in retail trade. Household confidence appears to be increasing, with growth in building approvals and finance commitments over the past year
- business confidence has also increased in recent quarters, along with private investment
- these positive factors have helped to increase employment in 2014, particularly full-time employment
- Tasmania's economy remains highly exposed to the strong Australian dollar

- much of Tasmania's agriculture industry is benefitting from strong demand and high prices, particularly dairy and livestock, and
- Tasmania's aquaculture industry is also set for further growth and is becoming an important source of employment growth.

In this context, the efficient development of the salmon aquaculture industry takes on a particularly important aspect. There would be significant economic costs in disrupting the growth of this industry by failing to properly capitalise it or in providing sufficient infrastructure to facilitate export growth. This can be seen from a consideration of the current internal structure of the Tasmanian economy, which is discussed in the next section.

The structure of the Tasmanian economy

Tasmania's natural resources have been its economic foundation for the past two centuries. Currently, it remains a small open economy heavily dependent on trade as a major source of income. This can be seen from consideration of the data below.

Table (9): Sector Distribution by Value Added and Employment – Tasmania 2013

Industry (by rank)	Value added	% of Total	Employment	% of Total
Rental, Hiring& Real Estate Services	2,671	12.74	2771	1.32
Manufacturing	2,234	10.65	18456	8.80
Construction	1,702	8.12	16138	7.69
Public Administration & Safety	1,674	7.98	19322	9.21
Financial & Insurance Services[14]	1.643	0.01	5207	2.48
Health Care & Social Assistance	1,554	7.41	25694	12.24
Education & Training	1,345	6.41	19295	9.20
Mining	1,260	6.01	2787	1.33
Retail Trade	1,193	5.69	24274	11.57
Electricity, Gas, Water and Waste Services	1,021	4.87	3565	1.70
Professional, Scientific & Technical Services	961	4.58	10083	4.81
Transport, Postal and Warehousing	956	4.56	9118	4.35
Wholesale Trade	938	4.47	6974	3.32
Agriculture, Forestry and Fishing	932	4.44	10198	4.86
Accommodation and Food Services	723	3.45	15571	7.42
Information, Media and Technology	627	2.99	3164	1.51

[14] Includes the earlier Business Services & Finance sector of the TNLM

Industry (by rank)	Value added	% of Total	Employment	% of Total
Administrative & Support Services	498	2.38	5651	2.69
Other Services	441	2.10	8041	3.83
Arts and recreation	236	1.13	3526	1.68
Total		100.00		100.00

Source: Tasmania economic profile, http://www.economicprofile.com.au/tasmania/economy/value-added

It can be seen that the largest value adding sectors are Rental, Hiring and Real Estate Services, Manufacturing, Construction, Public Safety and Administration and Financial and Insurance Services. In terms of employment, Health Care and Social Assistance, Retail Trade, Education and Training and Accommodation and Food Services are the largest. Moreover, accommodation and food services have shown the greatest rate of growth in recent times.

The extent of structural change over the last five to seven years can be seen by a change in the ordering of industries by value added and employment. In 2008, Manufacturing had the largest value added with Construction being ranked 10th and Rental, Hiring and Real Estate Services being ranked 18th. The employment data shows the significant increase in service industries as an employer of labour over the five to seven year period. It is important also to note recent growth in the contribution made by 'Tourism' and 'ICT' sectors to the economy, although these activities straddle more than one industry sector and are often not picked up by or are under-represented by official statistics.

Appendix 2: Non-Linear modelling

Non-Linear Input Output Models[15]

The Non-Linear Input-Output Model (NLIO) seeks to remove one of the major limitations of standard input-output analysis by removing the assumption of linear coefficients for the household sector and allowing marginal income coefficients adjustment. This is because, as is widely known, the household sector is the dominant component of multiplier effects in an input-output table. As a result using marginal income coefficients for the household sector will provide a more accurate, and empirically more valid, estimate of the multiplier effects, which in turn, provides results closer to those of a computable general equilibrium (CGE) model. The transactions flows in the input-output table can be expressed in matrix equation form as:

$$\mathbf{T}(\hat{\mathbf{X}}^{-1})\mathbf{X} + \mathbf{Y} = \mathbf{X}$$

That is, for each industry, total industry sales equals intermediate sales to other industries for further processing plus sales to final users, where T is the matrix of intermediate transactions, X is the column vector of sector total outputs and Y is the column vector of aggregate final demands. This can be rewritten as:

$AX + Y = X$

Where A is the matrix of direct coefficients which represents the amounts of inputs requires from sector *i* per unit of output of sector *j*. Thus, for a given direct coefficient matrix, it is possible to solve the set of simultaneous equations to find the new sector production levels X which will be required to satisfy a potential or actual change in the levels of sector final demands Y. By rearranging and converting to differences, this equation can be rewritten as:

$$\Delta\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\Delta\mathbf{Y}$$

where $(\mathbf{I} - \mathbf{A})^{-1}$ is termed the total requirements table, Leontief inverse matrix or general solution, and represent the direct and indirect change in the output of each sector in response to a change in the final demand of each sector. ΔY can incorporate any element of final demand expenditure, including household expenditure, government expenditure and capital expenditure.

This model is a linear model in which the A matrix represents a (constant) matrix of average input propensities. Normally, the A matrix endogenises[16] the household sector so that household consumption induced effects can be measured. This is referred to as the Type II model; the alternative Type I model is where households are treated as exogenous to local economic activity. Generally speaking, the consumption-induced effects are the largest component of the total multipliers. This is because consumer driven consumption (and income) to a large extent dominates local economic activity.

Total inputs are equal to intermediate inputs plus primary inputs (labour and capital). In the conventional input-output model, the inputs purchased by each sector are a function only of the level of output of that sector. The input function is assumed linear and homogeneous of degree one, which implies constant, returns to scale and no substitution between inputs. A more reasonable assumption is to allow substitution between primary factors. If there is an expansion in economic activity, say due to a development project, employers will attempt to increase output without corresponding proportional increases in employment numbers, particularly in the short term, e.g. construction projects, where there are economies of scale in getting the existing workforce to work longer hours rather than employ additional persons. This occurs for two reasons.

First, there is evidence in Australia that labour productivity (output per employee) is increasing over time. Secondly, as companies strive to reduce costs and satisfy the micro-economic reform processes imposed on all states by the National Competition Policy, there is evidence of a shift in primary factor use from labour

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15 The description of the Non-linear model properties is taken from CEPM model descriptions (West 2003)

16 That is, household income varies with the level of intersectoral activity.

to capital. This implies that the conventional input-output model has a tendency to overestimate impacts, in particular the income and employment impacts. Therefore, a more realistic approach to modelling impacts is to replace the average expenditure propensities for labour income by employers with marginal input propensities. In other words, the household income row in the A matrix, which are average input coefficients, should be replaced by income elasticities of demand. Note that, as in the CGE model, the linear coefficients assumption between intermediate inputs, and also total primary inputs, and total inputs is retained.

One problem associated with this approach is that the solution procedure is now more complex. Now the income impacts will be a function of ΔX but the income coefficients are included in the A matrix which determines ΔX. Therefore the equation set becomes recursive; ΔX depends on A and A depends on ΔX. Solving the input-output equation therefore requires an iterative procedure, a common method being the Gauss-Seidel method.

The income and employment flow-ons from the initial impact also need to be modified. In the conventional input-output model, income and employment flow-ons are calculated as linear functions of the output flow-ons, but in the revised model the parameters relating income to output are no longer constant. The impact on household income needs to be calculated as the difference between the base (i.e. before impact) income levels and the post impact income levels. It can be shown that this is equivalent to using the matrix equation:

$$\Delta \mathbf{Inc} = \hat{\mathbf{X}}_0^{-1}(\Delta\hat{\mathbf{X}})\hat{\mathbf{L}}\mathbf{U}_0$$

where U is a vector of household income flows and L is a vector of sectoral household income elasticities of demand. The zero subscript denotes the base level values and the hat denotes a diagonal matrix formed from the elements of the corresponding vector. This equation simply states that, for each sector, the change in household income payments equals the proportional change in output times the base level income payments multiplied by the income elasticity of demand. These income elasticities of demand can be shown to be equal to:

$$I_j = \eta_{WX} + \eta_{EX}$$

where ηWX is the elasticity of wage rate with respect to output, and ηEX is the elasticity of labour demand with respect to output; that is, they are made up of two components, the wage price component and the labour productivity component.

Similarly, the change in sectoral employment can be calculated as the change in the sectoral wage bill times the wage rate:

$$\mathbf{\Delta Emp = \hat{H}_0^{-1}\hat{P}_0^{-1}\Delta Inc}$$

where H is a vector of average household income coefficients and P is a vector of coefficients representing average output per employee.

There are several implications arising from the use of this model, compared to the conventional input-output model. Firstly, while the output multipliers and impacts should not be significantly different between the two models, we would expect the income and employment impacts to be smaller in the marginal coefficient model. This is because many industries, especially those which are more capital intensive and can implement further productivity gains, can increase output, particularly in the short run[17], without corresponding proportional increases in employment and hence income payments.

Secondly, unlike the conventional input-output model in which the multiplier value is the same for all multiples of the initial shock, the multiplier values from the marginal coefficient model vary with the size of the initial impact. Thus larger changes in final demand will tend to be associated with smaller multipliers than small changes in final demand. Therefore, the differential impacts of the marginal coefficient model are not additive, unlike the conventional (linear) Leontief model and CGE model.

[17] The term 'short run' here does not refer to any specific time period; rather it will vary from industry to industry. It is used here in the conventional economic sense to mean that the full adjustment from any shock has not had time to occur, i.e. the system has not yet returned to full, long run, equilibrium

Overall, within the confines of a static model, the major improvements brought by the non-linear model are to improve the overall accuracy of the factor income and employment impact projections.

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