ECONOMIC IMPACTS

OF THE CLOSURE OF YABULU NICKEL REFINERY

Prepared for

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Executive Summary

Background

The Queensland Nickel (QN) Yabulu Refinery is a major North Queensland operation, until recently providing employment for around 780 people. The Yabulu Refinery forms a key part of Townsville's minerals processing supply chain alongside Sun Metals Zinc and Glencore Copper Refinery.

QN was recently placed into voluntary administration due to financial difficulties associated with ongoing low nickel prices. Prior to going into voluntary administration 237 of the company's workforce were made redundant.

This report provides a high-level assessment of the potential economic impacts of the closure of Yabulu Nickel Refinery (should it occur), to the North Queensland (Northern Statistical Division) and State economies.

Input-Output (I-O) modelling is utilised to assess the potential economic impacts.

Outcomes

The decline in economic activity associated with a closure of Yabulu Nickel Refinery would be substantial. Within **North Queensland** the refinery is estimated to support on an ongoing annual basis:

- **$1.1 billion in output** (including $680 million directly and $400 million indirectly)
- **$220 million in Gross Regional Product** (GRP) per annum (including $40 million directly and $180 million indirectly)
- **$150 million in incomes and salaries** paid to workers (including $70 million directly and $80 million indirectly)
- **1,970 Full-Time Equivalent (FTE) jobs** (including 780 directly and 1,190 indirectly).

Across **Queensland** (due to the greater flow-on implications) the Yabulu Nickel Refinery is estimated to support the following annual economic activity:

- **$1.7 billion in output** (including $680 million directly and $1.0 billion indirectly)
- **$530 million in Gross State Product** (GSP) (including $40 million directly and $490 million indirectly)
- **$310 million in incomes and salaries** (including $70 million directly and $240 million indirectly)
- **3,960 FTE jobs** (including 780 directly and 3,180 indirectly).

Beyond the direct and flow-on economic impacts, the closure of Yabulu Nickel Refinery would have further substantial implications for the viability of regional supply chains as well as business and investor confidence across North Queensland.

The Yabulu Nickel Refinery is a major North Queensland and State industry driver. The loss of such an industry presence is likely to generate significant and long-lasting negative impacts on both the regional economy and Queensland-wide.

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1. Introduction

1.1 Background

The Queensland Nickel (QN) Yabulu Refinery is a major North Queensland operation, until recently providing employment for around 780 people. The Yabulu Refinery forms a key part of Townsville's minerals processing supply chain alongside Sun Metals Zinc and Glencore Copper Refinery.

QN was recently placed into voluntary administration due to financial difficulties associated with low nickel prices. Prior to being placed in voluntary administration 237 of the company's workforce were made redundant.

1.2 Purpose of this Report

This report provides a high-level assessment of the economic impacts of the closure of the Yabulu Nickel Refinery (should it occur), to the North Queensland (Northern Statistical Division) and State economies.

Input-Output (I-O) modelling is utilised to assess the potential economic impacts; an overview of the I-O modelling methodology is provided as Appendix A of this report.

2. Yabulu Nickel Refinery Overview

2.1 Refinery History

The Palmer Nickel and Cobalt Refinery (Yabulu Nickel Refinery) is operated by QN and is located approximately 25km north of Townsville. The refinery became operational in 1974 after completion of the Greenvale to Yabulu railway line. Mining at Greenvale took place between 1974 and 1992 during which nickel laterite ore was transported to the Yabulu Refinery by rail and processed up until 1993 (QN, 2016).

Importation of ore from mines in New Caledonia, Indonesia, and the Philippines commenced in 1986. Ore from these countries continues to be processed at the refinery.

Entrepreneur and current Federal Member for Fairfax Clive Palmer purchased Queensland Nickel in 2009 from previous owners BHP Billiton.

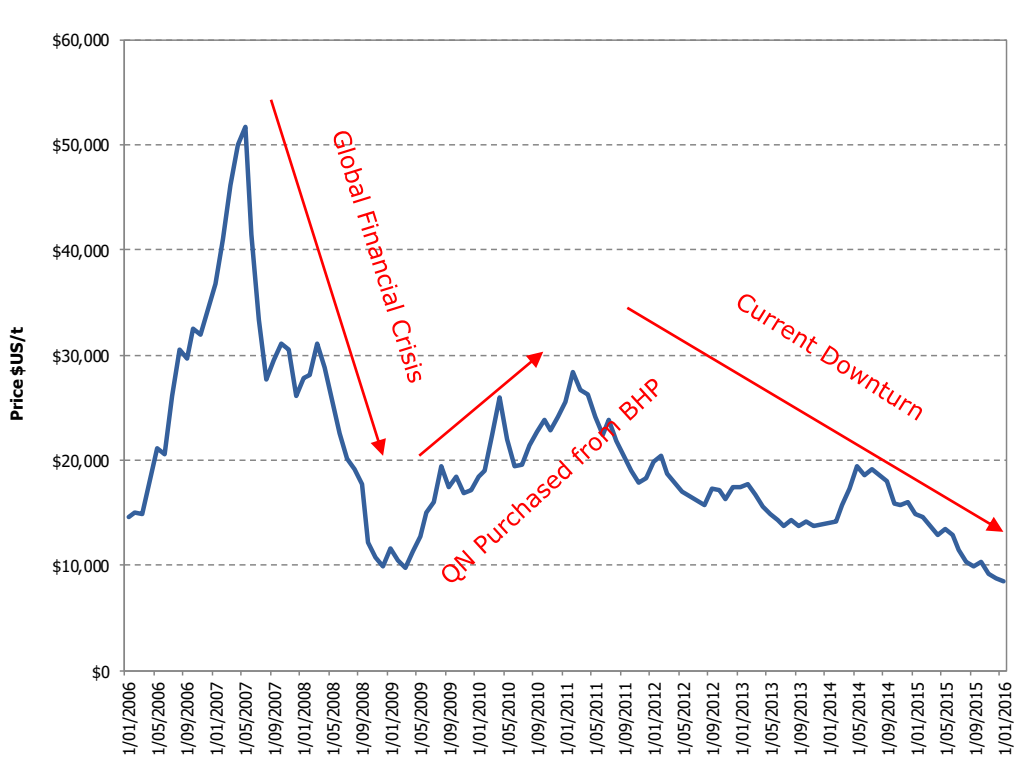
Approximately 780 people were employed by the refinery at the start of 2016. The facility produces around 30,000 tonnes of nickel per annum in addition to significant cobalt production (ABC News, 2016). The company recently made 237 workers redundant and on 18 January 2016, QN entered voluntary administration.

The major driver of the decline in viability of Yabulu Nickel Refinery has been the fall in global nickel prices. Prices have been declining since 2011 and are currently at more than 10-year lows at less than US$10,000/tonne (see Figure 2.1).

A range of factors have contributed to the decline, including a maturing Chinese economy (with the majority of nickel utilised in stainless steel production), generally subdued global economic growth and increased supply dating back to expansion during the previous resources boom.

The falling Australian dollar has helped to offset the price impacts for local operations to a degree. However, the high cost of Australian operations has created difficulties for manufacturers across a broad range of industry sub-sectors.

Figure 2.1: Nickel Prices ($US/t)



Source: World Bank (2016).

2.2 Refinery Operations

Ore is currently transported from a handling facility at the Port of Townsville to the refinery by rail. On arrival at the refinery, ore is removed from the rail wagons by a rotary tippler. From the tippler, the ore is conveyed to a radial stacker from which the ore is trucked to solar drying stockpiles. The ore is reclaimed and moved along a conveyor system and fed to three rotary driers to remove moisture. The dry ore is fed into ball mills, where it is ground to a fine powder (QN, 2016).

Following the grinding process, the fine ore is mixed with fuel oil reductant and fed into multi-hearth furnaces where the nickel and cobalt compounds are reduced at very high temperatures to reactive metals. The hot ore is cooled then leached in an ammonium carbonate solution and the nickel and cobalt dissolve into soluble amines. The nickel and cobalt amines are separated from the waste products by progressively washing in fresh ammonia solution in eight thickeners. Waste materials are pumped to and stored in the tailings dams (QN, 2016).

Nickel is separated from the cobalt by the ammoniacal solvent extraction (ASX) process and nickel carbonate is precipitated from solution by boiling off ammonia. By calcining the carbonate at 1,200°C it is converted to nickel oxide. The nickel oxide is then converted to metal at 1,000°C in a hydrogen atmosphere.

The majority of the output from the refinery is in the form of nickel metal compacts which are packed in containers for export to international markets.

Cobalt, the other valuable product of the refinery, is separated from the metal-laden ammonia solution as cobalt sulphide. Cobalt sulphide is then processed further in the cobalt plant to produce value-added cobalt products (QN, 2016).

3. Economic Impact Assessment

3.1 Approach

Economic modelling in this section estimates the economic activity supported by the Yabulu Nickel Refinery. I-O modelling is used to examine the direct and flow-on activity expected to be supported within the regional and Queensland economies (geography examined are outlined in section 3.2). Modelling drivers used in the assessment are described in section 3.3. A description of the I-O modelling framework used is provided in **Appendix A**.

I-O modelling describes economic activity by examining four types of impacts:

- **Output**: Refers to the gross value of goods and services transacted, including the costs of goods and services used in the development and provision of the final product. Output typically overstates the economic impacts as it counts all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once.
- **Value added**: Refers to the value of output after deducting the cost of goods and services inputs in the production process. Value added defines the true net contribution and is subsequently the preferred measure for assessing economic impacts.
- **Income**: Measures the level of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the project.
- **Employment**: Refers to the part-time and full-time employment positions generated by the economic stimulus, both directly and indirectly through flow-on activity, expressed in full-time equivalent (FTE) positions[1].

I-O multipliers can be derived from open (Type I) models or closed (Type II) models. Open models show the direct effects of spending in a particular industry as well as the indirect or flow-on (industrial support) effects of additional activities undertaken by industries increasing their activity in response to the direct spending.

Closed models re-circulate the labour income earned as a result of the initial spending through other industry and commodity groups to estimate consumption induced effects (or impacts from increased household consumption).

The following estimates consider both Type I and Type II flow-on impacts. However, it should be noted that Type II impacts are commonly considered to overstate economic activity.

3.2 Geographic Scope

The assessment examines the economic impacts of a potential Yabulu Nickel Refinery closure across the North Queensland (Northern Statistical Division) and Queensland.

3.3 Model Drivers

For the purposes of modelling, the annual economic activity supported by Yabulu Nickel Refinery has been estimated based on a Full-Time Equivalent (FTE) employment estimate of 780 positions (employment levels prior to the recent reduction).

From this employment level, estimates of direct turnover were made utilising the employment to output ratios based on the transaction tables for the North Queensland and Queensland economies developed for this project.

[1] Where one FTE is equivalent to one person working full time for a period of one year.

For modelling purposes, direct output was allocated to the to the most relevant industry represented in the I-O model, based on the Australian and New Zealand Standard Industrial Classification (ANZSIC) categories (basic non-ferrous metal manufacturing).

3.4 Model Results

3.4.1 Operations Phase

The decline in economic activity associated with a closure of Yabulu Nickel Refinery would be substantial. Within North Queensland the refinery is estimated to support on an ongoing annual basis:

- $1.1 billion in output (including $680 million directly and $400 million indirectly)
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- $150 million in incomes and salaries paid to workers (including $70 million directly and $80 million indirectly)
- 1,970 FTE jobs (including 780 directly and 1,190 indirectly).

Across Queensland (due to the greater flow-on implications) the Yabulu Nickel Refinery is estimated to support the following annual economic activity:

- $1.7 billion in output (including $680 million directly and $1.0 billion indirectly)
- $530 million in Gross State Product (GSP) (including $40 million directly and $490 million indirectly)
- $310 million in incomes and salaries (including $70 million directly and $240 million indirectly)
- 3,960 FTE jobs (including 780 directly and 3,180 indirectly).

Economic activity supported across North Queensland and Queensland as a whole are highlighted in the table below.

Table 3.1. Economic Activity Supported by Yabulu Nickel Refinery

Impact	Output ($M)	Gross Value Added (GVA) ($M)	Incomes ($M)	Employment (FTEs)
North Queensland				
Direct	$680	$40*	$70*	780
Type I Flow-On	$200	$60	$30	430
Type II Flow-On	$200	$120	$50	760
Total	**$1,080**	**$220**	**$150**	**1,970**
Queensland				
Direct	$680	$40*	$70*	780
Type I Flow-On	$540	$210	$110	1,360
Type II Flow-On	$500	$280	$130	1,820
Total	**$1,720**	**$530**	**$310**	**3,960**

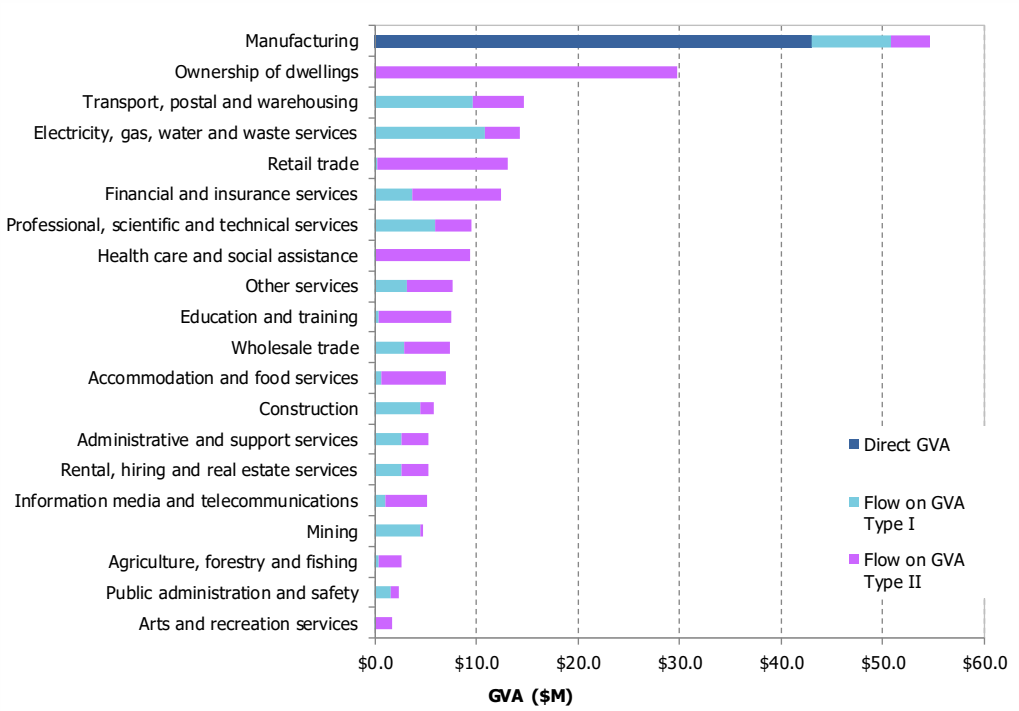
Note: * The transaction tables utilised for this assessment indicate that the industry ran at a loss over the financial year. Totals may not sum due to rounding.
Source: AEC.

A breakdown of annual GVA by industry which is supported by refinery operations is presented in the figures below.

Major North Queensland industry sectors which would be impacted by a closure include:

- Manufacturing (refinery supports over $50 million GVA per annum)
- Ownership of dwellings ($30 million per annum)
- Transport, postal and warehousing ($15 million per annum).

Figure 3.1. GVA Supported by Industry, North Queensland ($M)

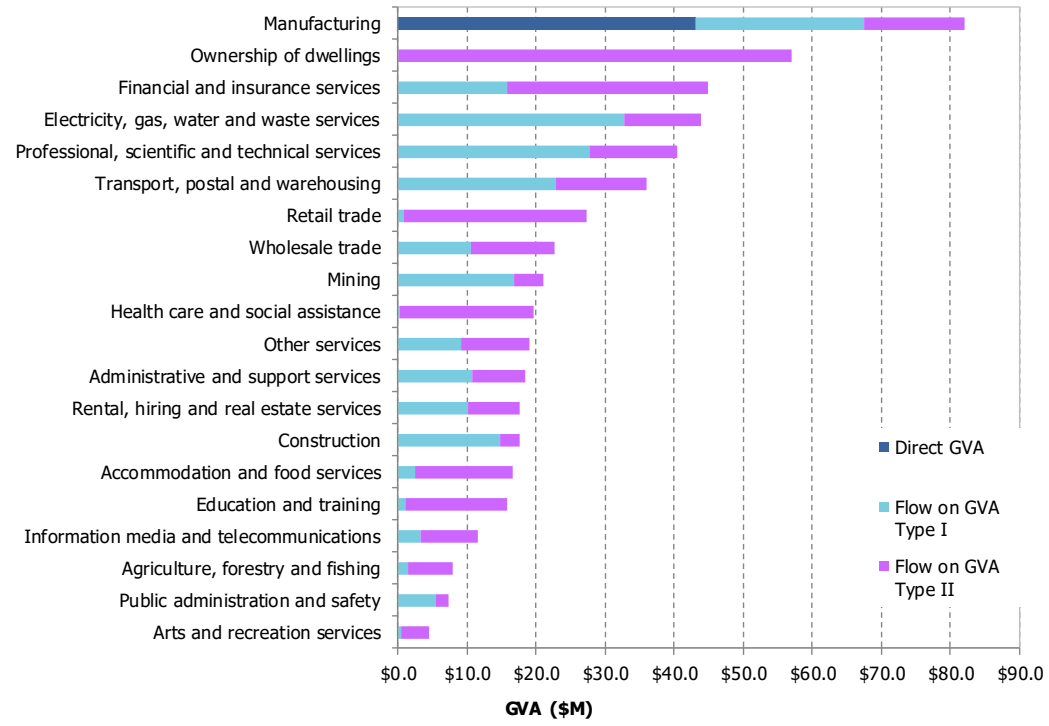


Source: AEC.

Across Queensland as a whole the major industry sectors to be impacted would be:

- Manufacturing (refinery supports $80 million GVA per annum)
- Ownership of dwellings ($60 million per annum)
- Financial and insurance services ($40 million per annum).

Figure 3.2. GVA Supported by Industry, Queensland ($M)



Source: AEC.

3.5 Other Socio-Economic Considerations

The economic impact assessment above outlines the transactional economic activity that is supported by the refinery in the North Queensland and State economies. However, I-O modelling does not appropriately measure less tangible social and community impacts. Other key impacts that can be expected should the refinery close include:

- **Loss of Viability within the North Queensland Minerals Supply Chain**: Yabulu Nickel Refinery is a major driver of activity through North Queensland's rail and port supply chain and is responsible for approximately half of the imports through the Port of Townsville (Port of Townsville, 2016). The loss of scale resulting from a closure would potentially have significant implications across the remainder of North Queensland's minerals supply chain
- **Loss of Business and Investor Confidence**: The closure of Yabulu Nickel Refinery would have significant flow-on implications for future confidence and investment in the North Queensland region. This impact could be particularly acute given the already high levels of unemployment and sluggish private sector investment
- **Potential for Long-Term Unemployment:** Some mature aged workers who have been employed at Yabulu Nickel Refinery for extended timeframes may have difficulty retraining or finding alternative employment given the specialised nature of the refinery employment. Long-term unemployment (periods over one year) are recognised as having a significant impact on individuals' skills and social capital (Senate Economics References Committee, 2015).

References

ABC News (2016). *Clive Palmer's Queensland Nickel Owes $100m and Needs Large Cash Injection to Continue Trading, Administrators Say*. Available from: http://www.abc.net.au/news/2016-01-29/hundreds-gather-townsville-queensland-nickel-creditors-meetin/7125110.

ABS (2012). *Census of Population and Housing 2011, Australia*. Available from: http://www.abs.gov.au/census.

ABS (2015). *Australian National Accounts: Input-Output Tables – Electronic Publication, 2012-13 tables*. Cat. No. 5209.0.55.001, Australian Bureau of Statistics, Canberra.

ABS (2016). *Consumer Price Index, Australia*. Cat. No. 6401.0, Australian Bureau of Statistics, Canberra.

Port of Townsville (2016). *Trade Statistics*. Available from: http://www.townsville-port.com.au/business-with-the-port/performance/trade-statistics.

QN (2016). *Queensland Nickel*. Available from: https://www.qni.com.au/.

Senate Economics References Committee (2015). *Inquiry into the Future of Australia's Automotive Industry*. Available from: www.aph.gov.au.

West, G. R. (1993). *User's Guide, Input-Output Analysis for Practitioners an Interactive Input-Output Software Package Version 7.1*. Department of Economics. University of Queensland, 1993.

World Bank (2016). *GEM Commodities*. Available from: http://data.worldbank.org/data-catalog/commodity-price-data.

Appendix A: Input-Output Methodology

Input-Output Model Overview

Input-Output analysis demonstrates inter-industry relationships in an economy, depicting how the output of one industry is purchased by other industries, households, the government and external parties (i.e. exports), as well as expenditure on other factors of production such as labour, capital and imports. Input-Output analysis shows the direct and indirect (flow-on) effects of one sector on other sectors and the general economy. As such, Input-Output modelling can be used to demonstrate the economic contribution of a sector on the overall economy and how much the economy relies on this sector or to examine a change in final demand of any one sector and the resultant change in activity of its supporting sectors.

The economic contribution can be traced through the economic system via:

- **Direct impacts**, which are the first round of effects from direct operational expenditure on goods and services.
- **Flow-on impacts**, which comprise the second and subsequent round effects of increased purchases by suppliers in response to increased sales. Flow-on impacts can be disaggregated to:
    - **Industry Support Effects (Type I)**, which represent the production induced support activity as a result of additional expenditure by the industry experiencing the stimulus on goods and services in the intermediate usage quadrant, and subsequent round effects of increased purchases by suppliers in response to increased sales.
    - **Household Consumption Effects (Type II)**, which represent the consumption induced activity from additional household expenditure on goods and services resulting from additional wages and salaries being paid within the economic system.

These effects can be identified through the examination of four types of impacts:

- **Output**: Refers to the gross value of goods and services transacted, including the costs of goods and services used in the development and provision of the final product. Output typically overstates the economic impacts as it counts all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once.
- **Value added**: Refers to the value of output after deducting the cost of goods and services inputs in the production process. Value added defines the true net contribution and is subsequently the preferred measure for assessing economic impacts.
- **Income**: Measures the level of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the project.
- **Employment**: Refers to the part-time and full-time employment positions generated by the economic shock, both directly and indirectly through flow-on activity, and is expressed in terms of full-time equivalent (FTE) positions.

Input-Output multipliers can be derived from open (Type I) Input-Output models or closed (Type II) models. Open models show the direct effects of spending in a particular industry as well as the indirect or flow-on (industrial support) effects of additional activities undertaken by industries increasing their activity in response to the direct spending.

Closed models re-circulate the labour income earned as a result of the initial spending through other industry and commodity groups to estimate consumption induced effects (or impacts from increased household consumption).

Model Development

Multipliers used in this assessment are derived from sub-regional transaction tables developed specifically for this project. The process of developing a sub-regional

transaction table involves developing regional estimates of gross production and purchasing patterns based on a parent table, in this case, the 2012-13 Australian transaction table (ABS, 2015).

Estimates of gross production (by industry) in the study areas were developed based on the percent contribution to employment (by place of work) of the study areas to the Australian economy (ABS, 2012), and applied to Australian gross output identified in the 2012-13 Australian table.

Industry purchasing patterns within the study area were estimated using a process of cross industry location quotients and demand-supply pool production functions as described in West (1993).

Where appropriate, values were rebased from 2012-13 (as used in the Australian national IO transaction tables) to 2015 values using the Consumer Price Index (ABS, 2016).

Modelling Assumptions

The key assumptions and limitations of Input-Output analysis include:

- **Lack of supply-side constraints**: The most significant limitation of economic impact analysis using Input-Output multipliers is the implicit assumption that the economy has no supply-side constraints so the supply of each good is perfectly elastic. That is, it is assumed that extra output can be produced in one area without taking resources away from other activities, thus overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.
- **Fixed prices**: Constraints on the availability of inputs, such as skilled labour, require prices to act as a rationing device. In assessments using Input-Output multipliers, where factors of production are assumed to be limitless, this rationing response is assumed not to occur. The system is in equilibrium at given prices, and prices are assumed to be unaffected by policy and any crowding out effects are not captured. This is not the case in an economic system subject to external influences.
- **Fixed ratios for intermediate inputs and production (linear production function)**: Economic impact analysis using Input-Output multipliers implicitly assumes that there is a fixed input structure in each industry and fixed ratios for production. That is, the input function is generally assumed linear and homogenous of degree one (which implies constant returns to scale and no substitution between inputs). As such, impact analysis using Input-Output multipliers can be seen to describe average effects, not marginal effects. For example, increased demand for a product is assumed to imply an equal increase in production for that product. In reality, however, it may be more efficient to increase imports or divert some exports to local consumption rather than increasing local production by the full amount. Further, it is assumed each commodity (or group of commodities) is supplied by a single industry or sector of production. This implies there is only one method used to produce each commodity and that each sector has only one primary output.
- **No allowance for economies of scope**: The total effect of carrying on several types of production is the sum of the separate effects. This rules out external economies and diseconomies and is known simply as the "additivity assumption". This generally does not reflect real world operations.
- **No allowance for purchasers' marginal responses to change**: Economic impact analysis using multipliers assumes that households consume goods and services in exact proportions to their initial budget shares. For example, the household budget share of some goods might increase as household income increases. This equally applies to industrial consumption of intermediate inputs and factors of production.
- **Absence of budget constraints**: Assessments of economic impacts using multipliers that consider consumption induced effects (type two multipliers) implicitly assume that household and government consumption is not subject to budget constraints.

Despite these limitations, Input-Output techniques provide a solid approach for taking account of the inter-relationships between the various sectors of the economy in the short-term and provide useful insight into the quantum of final demand for goods and services, both directly and indirectly, likely to be generated by a project.

In addition to the general limitations of Input-Output Analysis, there are two other factors that need to be considered when assessing the outputs of sub-regional transaction table developed using this approach, namely:

- It is assumed the sub-region has similar technology and demand/ consumption patterns as the parent (Australia) table (e.g. the ratio of employee compensation to employees for each industry is held constant).
- Intra-regional cross-industry purchasing patterns for a given sector vary from the national tables depending on the prominence of the sector in the regional economy compared to its input sectors. Typically, sectors that are more prominent in the region (compared to the national economy) will be assessed as purchasing a higher proportion of imports from input sectors than at the national level, and vice versa.

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