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Measuring the Economic Impact of Ports

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Abstract

Ports have received much recent attention from microeconomic reformers. One of the stated aims of reform is to increase competitiveness, to get more output relative to inputs, in comparison with other transport facilities and competing overseas ports.

Like any industry, ports have an effect on their local economies. They do this through direct employment, the facilitation of business between importers and exporters and their suppliers and customers, and by demanding inputs from regional businesses that supply the port with resources. In addition, some households consume local goods and services with money obtained either directly or indirectly from port activities creating flow-on effects.

This paper draws on a literature review conducted in preparation for a broader project the BTE is undertaking for the AAPMA to construct a general framework for estimating the regional economic impact of ports. The main issue examined is the measurement of secondary impacts. That is, the economic impact experienced by the wider regional community as port-related businesses purchase inputs (labour and material) from other firms in the area, and the effects of port employees spending money locally on goods and services. It examines the use of input-output analysis, comparing it with alternative methods, with respect to the rigour and quality of information they provide, the resources used to conduct them and the circumstances in which they might be better options. It discusses the variables to observe and data required.

The paper also discusses the limitations of a survey-based input-output analysis of economic impact, and indicates the approach that will be taken in the BTE framework to estimate economic impact and deal with practical problems in applying the methods.

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Introduction*

Douglas Adams once observed that it could hardly be a coincidence that no language on earth has ever produced the expression 'as beautiful as an airport'. The same could be said of many seaports. A seaport takes up space, takes people's time away from leisure and alternative production and attracts resources that might be used to produce other things. It might also spoil an attractive harbour shore. Yet most ports make a fundamental contribution to their regions' economies. In the ongoing debate about how best to use an economy's environmental, material and labour resources, it is in a port's interest to have at hand a set of methods to articulate this contribution.

At one level, ports' impact relates to their reason for being: they facilitate the movement of goods and people, they make business cheaper and consumption richer by receiving imports, and they allow local producers to export their commodities to buyers in other regions. For the carriage of certain classes of cargo, they are the only feasible mode of transport. Garrison and Souleyrette (1996) suggest that transportation infrastructure improvements generally enable innovation and economic development in other industrial sectors. At this level, transport generally and ports in particular have dynamic, technological and developmental economic effects – they stimulate economic growth, lower costs and enhance living standards over time.

At a more immediate level, their impact is the same as that of any other industry. Several firms exist to carry out the business of the port. Many other local firms' business is primarily or partly concerned with supplying them with inputs. And they give work and wages to thousands directly and indirectly. In addition, port employees spend their income on local goods and services. The perpetual and immediate impacts of ports are not mutually exclusive, but the measurement of each requires different techniques.

The immediate regional economic impact of ports is the subject of a project currently being undertaken by the Bureau of Transport Economics (BTE) for the Association of Australian Ports and Marine Authorities (AAPMA). The report will describe a general methodological framework that planners and policy-makers can apply to determine the regional economic impact of a port's activities. The BTE makes a primary methodological recommendation, but also describes alternative approaches for examining economic impact at a different level of detail, or those without the resources to devote to a study of total impact.

Pleeter (1980, p. 7) says that there 'are two basic ingredients to an economic impact analysis: an estimate of the exogenous or differential stimulus that serves as the direct impact, and a model of the regional economy that will produce estimates of the indirect effects.' Direct impact may be measured in different ways, but essentially it involves a

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census of the businesses and employees directly involved in the primary business of the port. DeSalvo (1994) defines the port industry as 'firms that provide services associated with moving cargo through the port system; certain activities not directly related to cargo flows but related to the port, such as ship repairs; and services provided to port users by [public sector] agencies, such as dredging services'. Measuring direct impact will be discussed further in the BTE's forthcoming report.

This paper is concerned with how to measure the secondary impacts: the flow-on effects experienced in the region as a consequence of the port's operations. They consist of the indirect impact of port businesses purchasing human and material inputs from local households and firms, and the induced impact of households consuming local products using income received from port activities. Secondary impacts are generally expressed as a multiple of the economic size of the local port industry. The paper first discusses the historical development of various techniques to measure the economic impact of ports. Next, it is argued that an input-output analysis is a rigorous and practical approach to obtaining multipliers if the aim is to achieve a detailed expression of the flow-on effects of various port activities and commodities handled. A discussion of the meaning and limits of the information this approach provides follows. It is also pointed out that alternative approaches have advantages if the ambitions of the study or resources available to undertake it are more modest. The paper then catalogues the practical options and constraints that Australian analysts would face when undertaking a study. Before concluding with some brief remarks, the paper broadly outlines the framework being applied by the BTE in its case study.

Choosing the story to tell

In analysing the economic impact of ports, analysts have taken an interest in several things. They are interested in how a port contributes to its region's economy, but there are various attempts to define and identify what comprises a 'contribution'. The BTE's work for the AAPMA is concerned with measuring and expressing (in dollars and jobs) the extent that a port is involved with its regional economy at one moment in time. In the past four decades, many methods have been developed to describe the economic consequences of ports. When analysts today choose between alternative methods, it is a decision driven by the prior questions 'What do we want to say about the port?' and 'What resources are available with which to investigate impact?'

According to Montalvo (1998), the US Federal Aviation Administration (FAA) suggests that the ideal, but generally impractical, way to represent the economic impact of an airport would be a so-called 'differential estimation approach': estimating what a regional economy would be like with and without an airport. The difference is then defined to be the airport's economic impact. A similar calculation would be useful for determining the economic impact of a seaport. It would take into account what port workers would be producing if they were not engaged in providing port services; it would count the use to which the port site would be put; it would estimate the alternative uses of all other inputs that go into port production. In some cases, those resources might be idle: some workers, materials and space might be unemployed in the

absence of a port. Others might be employed in the production of goods and services with a different economic value and different local input. The production never undertaken because of the port's existence is closely allied to the economist's concept of 'opportunity cost': the true cost of an economic activity is the value of that which is forgone.

What makes a differential estimate impractical, says the FAA (quoted in Montalvo 1998, p. 183) is that the 'time and resources required for this exercise will seldom warrant the resulting improvement in the estimates of employment, payroll and expenditure impacts'. Their preferred method, and the method usually followed in studies of the economic impact of transport terminal facilities such as ports and airports, is to estimate the direct, indirect and induced impacts separately and as they are produced, without reference to the counterfactual case. In essence, impact studies of ports represent an economic almanac: an aggregate of data on all wages, salaries, government revenue and production generated locally in one year attributable to the operation of the port.

According to Slack, Vallée, Comtois and Lagionmière (1993, p. 4), economic impact analysis methods were first developed to study the regional effects of ports. DeSalvo's (1994) and Davis' (1983) surveys refer to studies undertaken from the mid-sixties, and Waters' (1977) critique of their methods and function shows that the general value and purpose of the studies has been in dispute. In his defence of port impact studies, Chang (1978) condenses Waters' criticisms into a petition of seven points. The first four deal with impact studies' use as a planning tool. Waters alleges that they are inadequately designed for planning. The ones he refers to in his study do not attempt to assess the incremental effect of changes in public port investment, nor do they take into account technological changes over time. In addition, they make an allegedly unwarranted assumption about the importance of exports from a region to its income, they assume constant prices and they assume that port expenditure has an induced impact on regional income. A cost-benefit approach, one that looks at the stream of costs and benefits in the port industry, aided by input-output analysis, is a superior method for analysing the effects of ports, according to Waters.

Chang's (1978) defence is to agree that impact studies are inadequate by Waters' (1977) standards, but suggests that those standards are not the ones the authors of the studies are trying to meet. Port economic impact studies are not in general undertaken to determine the net benefits of ports' operations, nor are they in general designed to show incremental effects. Most of the studies, then and now, attempt a static estimation of the direct, indirect and induced impacts within a region.

There are exceptions, however. For example, DeSalvo (1994) recommends conventional supply and demand analysis to estimate the cost effects of the port's absence and changes in demand for exports and different types of imports. But his recommendations have not to his knowledge received practical application (pers. comm. DeSalvo 1999). The Rowland Company (1995) estimated the economic benefits afforded by the Port of Esperance of cost savings to local industry rather than conducting a conventional economic impact study. The port handles mainly bulk cargo and its value lies in reducing the costs of inputs for other firms. Rowland Company therefore chose to

identify the cost savings and benefits provided to the rest of the community. Other analysts might be interested in the environmental consequences of ports, their effects on land use or demography or transport mode substitution and choose different tools for the job. Economics is a rhetorical social science (McCloskey 1983) and different economic tools are rhetorical devices telling different stories. Of course, they may be used in combination to provide analyses from different viewpoints. For a more comprehensive survey of alternative techniques used to discuss other aspects of transport facilities' economic effects, see Cambridge Systematics Inc. (1998).

So you've decided to estimate the economic impact of a port? You'll be needing multipliers

The initial phase of an investigation into the regional economic impact of a port involves conducting an audit, or census, of businesses involved in port activities. The study should estimate relevant variables such as employment numbers, household income, where port businesses buy their inputs and what their value is, and other data assisting the economic evaluation of their activities. A survey is a convenient tool commonly employed in these exercises.

The next step is to obtain multipliers. Multipliers are used to calculate the effects of spending undertaken by port businesses and employees in the wider regional economy. This paper will discuss the main alternative methods used to obtain these multipliers. Pleeter (1980, p. 7) points out that there is an endless variety of methods that 'resist categorisation'. Among the many techniques that have evolved over the decades, some are extinct, others are hybrids, a few are unhappy mutations of ancestors, while some innovations have survived to be reproduced over and again. Once analysts obtain numbers representing the direct impact of a port, they can apply multipliers to express indirect and induced economic impact in the local region as a multiple of direct impact. (For example, indirect impact in terms of household income might be 1 8 times wages and salaries earned by port employees, or each job in the port community might generate work for one and a half jobs in the local region.) Time and resources will play a large part in the decision about the method with which to derive multipliers, but accuracy and the information each can provide must be important too. For explanatory power, input-output analysis appears to be the most popular method. But there are other approaches.

The following discussion describes alternatives in their simplest form. Analysts can generally elaborate each approach to provide a more sophisticated abstraction of economic impact.

Borrowing multipliers

The quickest and easiest of methods, borrowing multipliers involves taking the multipliers published in another case study, or multipliers developed at the state or national level, and applying them to the estimated direct impact of the port. The method

is an option for ports with few resources to devote to the estimation of economic impact, or for analysts after an idea of the magnitude of numbers to expect from a more comprehensive study of total impact.

A number of studies conveniently publish tables of multipliers with varying levels of detail. Indirect and induced employment, production and income impacts are often available by specific port activities as well as by particular commodities handled in the port.

A port that is similar to a recently studied port – similar, that is, in size, function, structure and relationship with its local region – might be adequately represented by the results obtained in the prior study. There are several reasons for the analyst to be cautious about importing multipliers from another port, however. Chief among them is that every port is different; every regional economy is different; and the borrowed multipliers are only as good as the methods used to obtain them. If the methods used to obtain the original multipliers are questionable, their application to another study is more so; on the other hand, if multipliers are rigorously developed, they are more likely to represent the specific character of the original port and regional economy. Analysts may increase their confidence by manipulating the figures to suit their port, but at some point it becomes more efficient simply to conduct an independent study.

Davis (1983) cites six overseas studies that take this path, and there are likely to be more. Cambridge Systems Inc. (1998) describes the strengths and weaknesses of similar methods (which it refers to as 'case comparisons'). The BTE's report will include detailed multipliers from a case study of an Australian port and a survey of multipliers obtained in Australian and overseas case studies. It is expected that ports with the resources to devote to a comprehensive estimation of economic impact will use these numbers as a guide only.

Economic base method

The economic base method appears to have lost much of its popularity as a method of conducting economic impact studies. Waters' (1977) article contained criticisms specific to this technique. Economic base models emphasise external influences on regional economies (Villaverde Castro and Coto-Millán 1998, p. 162). In fact, the model represents the economy as two sectors: one is a local sector that produces goods and services consumed within a region. The other is a 'basic' sector that produces goods and services sold outside the region or those activities technically linked to export activity (Davis 1983, p. 63). In this model, local income is determined primarily by external demand for exports from the region. A simple version of this model might take the form (Villaverde Castro and Coto-Millán 1998, p. 162):

$$Y = B + L$$

Y is total regional income, B is the basic or export sector and L is the local sector. L is itself an increasing function of regional income, so $L = sY$ (where s is a 'positive parameter that must be estimated empirically' (Villaverde Castro and Coto-Millán 1998, p. 163)). Substituting sY for L in the original expression, and rearranging gives:

$Y = [1/(1 - s)] B$

The economic base multiplier is represented by the expression $[1/(1 - s)]$. This economy would experience an economic impact (a change in Y) given a change in the export or basic sector B, proportional to the parameter, s

Villaverde Castro and Coto-Millán (1998, p 163) describe three weaknesses of the method:

> Firstly, it considers as a non-basic (or endogenous) sector all activities related to the flow of imports. Secondly, the model only provides an aggregate multiplier, which implies, for example, that a substantial increase in exports of a determined good has exactly the same multiplying effect as an equal increase in exports of a different good. Lastly, this model only computes the induced effect, without offering any assessment of the indirect effect.

Notwithstanding these problems, the economic base method might be appropriate where resources are scarce, and where the commodities traded via a port are concentrated to a few exports that have a pronounced, identifiable relationship with local income levels (Pleeter 1980, p. 10)

Keynesian multipliers

Sometimes Keynesian multipliers are referred to in the literature as 'econometric models'. The approach uses well established income accounting identities derived from the works of the economist John Maynard Keynes to identify changes to income levels resulting from changes in investment, consumption, exports, imports and government spending. Econometric models do not necessarily describe Keynesian identities, but Keynesian multipliers are estimated using econometrics. For a more general discussion on the use of econometric and statistical techniques to evaluate economic impact, see Cambridge Systems Inc. (1998)

Keynesian multipliers are derived from models that assume economies are open (they import and export) and that some factors are endogenous (for example, income levels affect consumption and imports) while some are exogenous (for example, export demand and government spending might be independent of the region's income levels). Like economic base models, the Keynesian approach emphasises the importance of external influences on local income levels (Pleeter 1980, p. 19). Like economic base models, they provide a single, aggregate multiplier with which to calculate secondary impacts.

A very simple Keynesian model might look like this:

$Y = C + I + G + aX - M$.

Where Y is income, C is domestic consumption, I is investment, G is government spending, X is exports and M is imports. For a change in exports (X), regional income (Y) would change according to the size of a, the coefficient to X, everything else

remaining the same. The value of *a* would be estimated empirically using regression techniques, or using established relationships between exports and income

According to Davis (1983, p 64), the Keynesian approach is a more flexible analytical tool than the economic base model. It allows the analyst to treat 'import-replacement activity in the port-region as an income generator. However, like the base model, the approach yields a single, aggregate multiplier designed to provide an estimate of the induced effect.'

Input-output analysis

Input-output tables are matrices of numbers describing transactions undertaken between various sectors in an economic system. Table 1 is a very simple example.

Table 1 **An input-output table of a three-sector economy (source: Leontieff (1987), p. 861)**

	Agriculture	Manufacturing	Households	Total
Agriculture	25	20	55	100 bushels
Manufacturing	14	6	30	50 yards of cloth
Households	80	180	-	260 man-years

The figures are interpreted so: Agriculture (which, in this economy, produces wheat) claims 25 bushels for its own use, provides 20 to manufacturing and supplies households with 55. Manufacturing supplies 14 yards of cloth to agriculture, uses 6 itself and supplies 30 to households. Households supply 80 hours of labour to agriculture and 180 to manufacturing. In this economy, households are supplied no labour, only leisure (something that is typically ascribed no productive value). Simple arithmetic reveals the technical coefficients (the proportion of inputs required to produce one unit of output in each sector). For example, to produce one bushel of wheat, agriculture needs 0.25 bushels of wheat, 0.14 units of manufactures and 0.80 man-hours of labour. A table of coefficients appears as table 2:

Table 2 **Technical coefficients in a three-sector economy (source: Leontiff (1987), p. 861)**

	Sector 1	Sector 2
Sector 1	0.25	0.40
Sector 2	0.14	0.12
Households	0.80	3.60

From table 1, we know that households demand 55 bushels of wheat and 30 yards of cloth. With household demand for wheat (y_1) and cloth (y_2) known, we can work out the total amounts of wheat (x_1), cloth (x_2) and labour (L) necessary to meet that demand from the solution to the following equation pair (Leontiff 1987, p. 861):

$$(1 - 0.25)x_1 - 0.14x_2 = y_1$$

$$-0.40x_1 + (1 - 0.12)x_2 = y_2$$

Solving for total amounts of wheat and cloth required to meet final demand gives the following equations:

$$1.457y_1 + 0.662y_2 = x_1$$

$$0.232y_1 + 1.242y_2 = x_2$$

Relationships such as these can be used to show the impact of different levels of final demand. Of course, a real economy has many more sectors than those represented above, but the principles are the same.

An input-output port economic impact study involves estimating the final demand on a region's productive sectors by the port community – that is, by determining the direct impact of a port according to the categories, volume and value of the inputs it demands from local suppliers. Taking these figures and going through an exercise similar to that illustrated above provides an estimate of the indirect impact of the port.

Finally, input-output tables may be further manipulated to provide estimates of induced impact. By obtaining the inverse of an input-output matrix, we can obtain information about the price relationships between various sectors, allowing analysts to infer the income, production and employment induced effects of direct and indirect port impacts. The detailed information provided by input-output multipliers has allowed analysts to examine the impact of Australian and overseas ports, presenting their results at quite a disaggregated level. Australian case studies using this method include the Ports of Sydney, Brisbane and Fremantle (Mills and Morison 1993; Jensen and Morison 1987 and McLeod and McGinley n.d.) and Canberra International Airport (ACIL Consulting 1998). Their reports provide information on the impact of various port functions (for example, navigational services and administration) and by cargo type.

Options, limits and difficulties of input-output based economic impact studies

An input-output approach to estimating economic impact provides an impressive level of detail about where in a regional economy impacts are experienced, and how much they are manifested in employment, wages and salaries, government revenue and production. In Australia, such analyses have been used to assess the economic impact of highways, ports, airports and international motor car races. A port economic impact study using this method, however, represents a fairly substantial labour

There are a few practical difficulties to be overcome. First, once the local region in which the impact is to be estimated has been defined, it will usually be found that there is no input-output table compiled for that region. Second, once an input-output table has been identified, created or modified to fit a region, it will generally not include sectoral classifications that describe a port industry, or what it does. Third, input-output tables date quickly.

A regional table

The Australian Bureau of Statistics publishes national input-output tables annually (ABS Cat. No. 5209.0 – *Australian National Accounts: Input-Output Table*) showing inputs by industry, output by commodity, employment by industry and multipliers. Using these tables by themselves is insufficient if an impact is to be identified within a region. The tables' structure and content are unlikely to represent a regional economy. Calculations using multipliers obtained straight from national tables

> are likely to involve substantial overestimation of the final effect. This is because national data contain no information on leakages from a region, other than the lower bound implied by national imports (Cooper 1998, p. 15).

Regional economies are not scale models of the nation's industrial sector. They would therefore be misrepresented by a national model. A region is better represented by a table showing its industrial specialties, what it produces and consumes locally, and what it exports and imports.

The are a few ways of developing a table to suit a region. First, one can be created from scratch. Second, the analyst might pare down a national table to a local region by judiciously selecting national industrial sectors and reallocating them as regional 'imports'. Cooper (1998) proposes a method whereby regional sampling and econometric estimation are conducted with reference to technical constraints found in the national tables to produce a regional model.

The boundaries of the region in which the impacts are measured are determined by practical considerations. The larger the area, the less is the relative importance of port activities to the region's economy. Another factor influencing the decision is data availability. Input-output tables will rarely be available for the desired region, but regional statistical classifications exist for other statistical purposes (for example, census information). The ABS definitions of metropolitan Brisbane, Perth and Sydney were used for port studies (Jensen and Morison 1987; McLeod and McGinley n.d.; and Mills and Morison 1993) although McLeod and McGinley provide their results for the whole of Western Australia.

Adding a port to the table

ABS input-output tables, and other tables not specifically created for the purpose of port economic impact studies, do not describe a port industry or the specific activities of a

port. They might have categories that encompass some port business, but the classifications generally include non-port related activities. Mills and Morison (1993, p. 26) describe two alternative methods for incorporating a new or existing firm into a study. If its impact is relatively insignificant, or

> if the firm is thought to show a cost structure (ie, a column in the [input-output] matrix) similar to the average existing firm in the table, the new firm can be adequately represented by the existing sector of the table without any significant strain on the assumptions of the model. If, however, the firm or industry ... is considered to be of some significance, or if the requirements of the study called for a detailed study of the firm or industry *per se*, a new row and column representing that firm or industry should be prepared and incorporated into the input-output table and a normal multiplier calculation carried out.

Most case studies use the second method, and it is the approach taken in the BTE framework. Published Australian tables do not readily describe port functions, so Australian case studies amended existing tables to accommodate them (Jensen and Morison 1987; McLeod and McGinley n.d.; and Mills and Morison 1993). Mills and Morison (1993) provide the most detailed account of the three case studies of how to incorporate a port into an input-output table. Their approach involves collecting data from a variety of sources (other ABS publications, the port authority and survey questions) to obtain sectoral profiles of port activities.

Using an old table

An input-output table will usually provide statistics from a time before the year of the port industry survey. The problem with using an older input-output table to demonstrate economic impact is that the economic relationships it describes might have changed. Technology and other internal and external factors can alter the relative importance and interrelationships of various industries. The fate of industries also depend on changes in demand, the arrival or disappearance of substitutes and complementary goods and services, or changing production cost effects of international trade and agricultural fecundity. A common solution is to accept small enough time differences, but if helpful data are available, the analyst might wish to judiciously update the table.

What input-output analysis does not say about economic impact

Like many powerful tools, input-output analysis is prone to misuse. Burns and Mules (1985) survey input-output analyses of a range of industries and find that studies using these methods can misrepresent the studies' findings. For example, they cite a report on the Adelaide Grand Prix that 'persistently uses the word "benefits"' (Burns and Mules 1985, p. 73). Three of their points regarding the limitations of input-output analyses are worth emphasising here:

Input-output analysis makes no distinction between benefits and costs: Burns and Mules' (1985) colourful example is of an increase in road accidents, which would be estimated to have a high impact (because it employs ambulance drivers, traffic police, panel beaters, and others) but which could hardly be described as providing benefits equivalent to the sum of their salaries. This is better known as the 'broken window fallacy'. Frederic Bastiat in an 1850 essay refuted the idea that a broken window involves a gain to society because it employs a glazier. What is not seen is that the window's owner might have spent the money he had to spend fixing his window on shoes instead. What is seen is that the window owner is worse off than he was before breaking his window by the cost of the repairs, but that the glazier is better off for being hired. What is not seen is that the window owner does not get the benefit of the new shoes, nor does the shoemaker get a sale.

Input-output multipliers are not indicators of the economic efficiency of resource use: If two firms produced the same level and value of output, but one firm used many more inputs to do so, that firm would have a greater impact, yet it would be less efficient.

Input-output multipliers are average values, not marginal values: For example, if the employment multiplier for an industry were 1.8, it should not be implied that one additional job in that industry would result in 1.8 jobs in the regional economy. If the economy has excess capacity, argue Burns and Mules (1985, p. 76), then an 'increase in one industry could be entirely absorbed by all related industries without any employment creation effect.'

Burns and Mules (1985) reiterate Waters' (1977) criticism that port economic impact studies cannot be used for planning. But they allow that, once a planning decision has been made, input-output analysis shows where the impact is likely to be felt. And, they say, this information might be particularly useful when economic development, rather than enhancing efficiency *per se*, is the main goal of investment.

Input-output analysis is not bereft of predictive power. Jensen (1989) uses the techniques developed for his earlier study of the Port of Brisbane (Jensen and Morison 1987) to estimate the impact of an increase in port output. But Burns and Mules' (1985) cautions are worth remembering when reporting or critically assessing estimates of a port's economic impact.

True also is that input-output based port impact analysis can only record the economic impact of a port measured against actual commercial transactions recorded in a statistical table. A port could also be expected to have economic consequences that are not captured by this static accounting. Environmental effects, welfare changes, the distribution of wealth and dynamic effects are not measured using these methods.

The BTE framework

A body of theoretical literature and the findings of other case studies informed the economic impact framework being developed by the BTE. The framework also incorporates practical insights from a case study of the Port of Fremantle currently

being undertaken by the BTE. The secret to a successful port economic impact analysis is to responsibly balance analytical rigour and data availability. The 'textbook' requirements of a study might rarely be satisfied entirely. There might be no recent input-output table that neatly partitions a regional economy or easily accommodates the imposition of a port industry. The proportion of surveys returned will seldom be total and, beyond an unreasonable level of monitoring of respondents, errors might slip through undetected and affect the final result. The BTE's report will help those applying the framework to deal with such problems.

The BTE encourages practitioners to deal with these problems in two ways. First, estimates produced by the study can be improved by statistical techniques and by minimising sources of error. That means putting effort into making sure the port community supports the study and understands what the survey will ask of it and why it is in the port community's interest to participate. It means spending time identifying ways to improve input-output analysis by incorporating other statistical sources and regional industry relationships. Second, the report will stress the need for transparency and completeness when presenting results. By describing the methods and sources used and any remaining limitations, analysts can effectively improve understanding of the results. The need to comply with these scholarly norms might seem obvious, but it is surprising how some studies obscure the processes and information underlying their analyses by denying readers the whole picture. A generous critic might say that these circumstances imply that those analysts do not understand the methods they use.

Claiming too much of results or failing to explain their derivation ultimately undermines them. The BTE framework attempts to provide a rigorous approach that reflects best methods.

The BTE will also observe that regional impacts are localised and will not necessarily translate to state or national impacts, and that any 'benefits' indicated might be offset by costs incurred elsewhere in the economy which are beyond the scope of the study to model.

Conclusion

Port economic impact methods have developed in the past four decades into a set of useful instruments. They can show how much and in what way a port is integrated with its region's economy, and express that integration denominated in employment levels, wages and salaries, the value of production and government revenue.

Coupled with a survey to estimate the direct impact of port activities, the most rigorous and popular method of determining how the port's impacts flows on to the rest of the region appears to be using input-output analysis. A study using this approach can provide a rich and detailed estimate of impact. The study could locate which port activities are causing the greatest impact, which commodities have the most flow-on effects and whether those impacts are being experienced as jobs, household income, or some other variable.

If the object of a port economic impact study is more modest than that, or if it has different objectives, then an alternative method should be considered. Because of its rigour, an input-output based economic impact study is a fair amount of work. If the object is to get an estimate of total economic impact without identifying details, or if the analyst is interested in the net effect of the port, then other methods should be examined as a potentially better investment of time and labour.

The framework for port economic impact analysis being developed by the BTE will present port staff, planners and policy-makers with the tools and information necessary to carry out a survey and complete an input-output based economic impact study. Studies undertaken using the framework should be broadly consistent with previous Australian case studies, and their results comparable with other studies using the framework. A common approach to port economic impact studies should help enlighten discussion about ports as part of a wider economy.

The BTE's framework will provide individual ports with a practical method for gathering information about a port's economic impact. Ideally, economic impact would be measured using approaches that more realistically capture causal relationships, changes over time, effects at the margin, welfare enhancement, and any other consequences that might interest policy-makers, industry and the general public. But for a partial analysis, the methods to be described in the framework represent an accepted and substantial way to collect and analyse available data.

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