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The use and abuse of economic modelling in Australia

Users' guide to tricks of the trade

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Technical Brief

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Introduction

> *"When I began the study of economics some forty one years ago, I was struck by the incongruity between the models that I was taught and the world that I had seen growing up"*   Nobel Prize Winning Economist Joseph Stiglitz.[1]

Economic modelling has, for many people involved in Australian policy debates, become synonymous with the process of serious policy development. Proponents of policy change that are armed with economic modeling are often taken more seriously than those with 20 years experience working on the same problem. The modelling result that suggests tens of thousands of jobs will be lost or created often trumps logic or experience that suggests such claims are nonsensical.

This is not to suggest that modelling has no role to play in policy debates. It can and it does often make a useful contribution, but the fact that it sometimes can should not be confused with the conclusion that it always will. Indeed, in recent times some of the claims based on 'economic modelling' that has been made in debates such as the likely impact of poker machine reform or the introduction of a carbon price can only be described as nonsense.

The problem has become, however, that in an era in which segments of the media no longer have the time or inclination to examine claims before they are reported bad economic modelling is preferred by many advocacy and industry groups to good economic modelling for three main reasons:

1. it is cheaper
2. it is quicker
3. it is far more likely to yield the result preferred by the client

That said, bad economic modelling is relatively easy to identify if readers are willing to ask themselves, and the modeller, a range of simple questions. Indeed, it is even easier to spot when the modeler can't, or won't, answer such simple questions.

What is modelling?

A model, be it a model car or model or an economic model, is a simplified representation of a more complex mechanism. A model is typically smaller, simpler and easier to build than a full scale replica. A model sheds light on the main features of the reality that it seeks to represent.

An economic 'model' is not a physical thing, like a model car. Rather, it is a mathematical representation of the linkages between selected elements of the economy. For example, an economic model of the link between economic growth and commonwealth tax revenue would usually be based on the historic relationship between economic growth and the amount of tax collected. A simple model might distinguish between the impact of changes in economic growth on income tax, Goods and Services Tax and company profits tax whereas a more complex model might distinguish between different types of economic growth (eg growth in exports, growth in consumer spending, growth in business investment) on a wider range of commonwealth taxes (capital gains tax, mining taxes, fringe benefits tax).

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[1]   Stiglitz, J. S (2001) Information and the change in the paradigm in economics, Prize Lecture, December 8, 2001, Columbia University, at <http://www.nobelprize.org/nobel_prizes/economics/laureates/2001/stiglitz-lecture.pdf>.

Given that no model will ever be a perfectly accurate predictor, nor cope well with unexpected events like the Global Financial Crisis (GFC) or the introduction of a new tax, the design of the models used by different organisations will be determined by the use to which they are to be put. For example, a model designed to shed light on the budget deficit or surplus for the following year will likely have less detail, but more capacity to predict the budget result, than a model designed by an investment firm to estimate the amount of mining tax likely to be paid by individual mining companies.

The strengths of economic modelling

A well designed model that is used by skilled practitioners to shed light on issues the model was designed to illuminate can make a significant contribution to policy debates and decision making. As discussed above, a well designed model can help shed light on the likely impact of changes in economic growth on government revenue. Models can also shed light on the likely impact of changes in GDP on employment, exports, imports and household spending.

It is very important to highlight, however, that there is a fundamental difference between the ability of a MODEL to describe the likely impact of a change in economic growth on variables such as tax revenue and employment and the ability of the MODELER to forecast what changes in economic growth are likely to occur. That is, economic models are relatively accurate in describing the link between a 'dependent variable' like employment and an 'independent variable' like GDP but that does not mean that they are at all accurate in guessing how the 'independent variables' will behave. No one, especially economic modellers, knows the future. But economic modellers are better than most at forecasting how different possible futures, or 'scenarios', will impact on a wide range of variables of interest.

The strength of economic modelling is, therefore, that it can provide a relatively rigorous and transparent (for those who read the fine print at least) mechanism for describing the likely outcomes of hand-picked scenarios. Anyone interested in understanding the likely consequences of a 2 per cent spike in GDP growth on government tax revenue should consult an economic modeller, but anyone interested in knowing what will happen to the Australian economy in 20 year's time should probably ask an astrologer, but only if the astrological advice comes for free.

Consider, for example, what an economic modeller would have forecast for the mobile phone and internet industry in 1980. Or imagine what a modeller in 1920 would have forecast for the demand for horses in 2020.

Economic models are virtually useless for making long run predictions about likely impact of structural or technological changes that have yet to occur. They are, however, good at predicting what the likely consequences of repeating a similar event to one that has happened previously. Any forecasts about the likely impact of a carbon price or the broadband network on the Australian economy in 20 year's time are made on the assumption that 'all other things will remain equal'. Given that the purpose of introducing a carbon price or broadband network is to change things such attempts at modelling are at best heroicly optimistic and, at worst, fundamentally deceptive.

The weaknesses of economic modelling

The biggest limitation with any economic model is summarized by the acronym GIGO, that is, Garbage In Garbage Out. If the scenarios being modeled are implausible or nonsensical then the 'results' of the modelling will be similarly worthless. For example, if the government were to model the impact of six per cent economic growth in 2012 on the budget surplus they would inevitably find that the budget would return to surplus far more quickly than had previously been thought possible. Six per cent economic growth would mean far higher

employment, income tax receipts, GST receipts and company tax rate receipts than had previously been expected. But, regardless of the rigor with which the linkages between GDP and the independent tax receipt variables had been estimated, the 'good budget results' would be nonsensical in the absence of very strong evidence that 6 per cent GDP growth was at all likely.

A similar, but harder to detect, problem arises when unrealistic assumptions are made about the linkages between variables. For example, an economic model might assume that there is a very strong link between the marginal tax rate and the number of people looking for work. And the same model might also assume that there is a very strong link between the number of people looking for work and the number of jobs that will be created. Such a model would in turn 'find' that if the government were to cut income tax rates that there would be a surge in the number of people looking for work and, in turn, a surge in the number of jobs created.

While it is of course possible that personal income tax rates are a major determinant of whether people look for work or not, and it is of course possible that the number of people looking for work is a major determinant of the number of jobs, it is logically impossible for a model that relies on such assumptions to be used as 'proof' that such relationships exist.

Unfortunately, as will be discussed below, economic models are frequently used to support conclusions that have, in fact, already been assumed. In most other academic disciplines such the process of recycling assumptions as conclusions is referred to a 'circular argument'. In economics, however, the practice has become quite common. For example, in Computable General Equilibrium (CGE) macroeconomic models it is explicitly assumed that in the long run the only variables that determine the level of GDP are the size of the labour force and the level of productivity. Again, while it is possible that this assumption that only those two variables matter, such models should not then be used to 'test' whether other variables might improve long run economic growth for the simple reason that the model has already assumed that they cannot.

Circuitously, having built models that are based on the assumption that only the size of the labour force and the productivity of the workforce can increase the long run rate of growth the Australian Treasury has subsequently concluded that the main three drivers of GDP growth that governments should focus on are the three Ps' of Population, Participation and Productivity. While there is no doubt that these are important macroeconomic variables there is also no doubt that they are the only variables with a significant capacity to influence the models of the economy relied on by Treasury.

Choosing the right horse for the right course

As described above, different models have different strengths and weaknesses and, in turn, an important part of the modelling process is to select the type of model that can shed the most light on the issues considered to be of the most importance while ignoring the smallest number of other elements of the problem that might be considered relevant. The significance of this need to select between a range of models means that, no matter how mathematically rigorous the specification of economic models is, the process of economic modelling will always be partly subjective.

Some models provide enormous detail on the impact of policy changes on a wide range of household types while others treat the entire household sector as one entity. Some models provide enormous detail on the impact of policy change on different industries while others provide great deal on different regions. The trade of between the small scale 'resolution' of a model and its accuracy means that models that attempt to simultaneously provide great detail on the impact on policy change on different household types, industries and regions are likely to be too inaccurate to rely on. The modeller, therefore, has to decide whether the

impact on household types or industry types is more important. Such a choice is inevitably subjective.

The fact that model selection is inherently subjective should not be seen as a fundamental problem, rather, it should be seen as a potential bias that needs to be recognised by the users of the modelling results. Ironically, however, economists are typically taught that subjectivity is 'bad' and that economists should always beware of making subjective evaluations.

For example, most introductory economics textbooks attempt to convince students that the difference between economics and other social sciences is that in other disciplines people seek to answer subjective, or normative, questions about what 'should be done' while in economics researchers confine themselves to questions about objective, or positive, questions about what 'is done'. That said, regardless of whether the economists undertaking the modelling wish to admit it or not, the whole point of constructing an economic model is to make decisions about which elements of a problem are more important and which elements can be safely ignored. The existence of these subjective judgements is not in itself problematic, rather, it is efforts to conceal the potential significance of these judgements that should be of concern to readers of modelling results.

Some economists might argue that they are upfront about their subjective choices and clearly explain that their model results only hold subject to the condition that 'all other things remain equal'. If the objective is to be clear with users about the significance of the assumptions made, however, it is unclear why economists often translate 'all other things remaining equal' into the less accessible Latin phrase of 'ceterus paribus' and why the introductory chapter of modelling results do not list the widely used assumptions that all markets are perfectly competitive, all consumers are rational and that there are no economies of scale.

The following sections provide a brief overview of some of the two most common types of economic modelling used in Australian policy debates, namely input output modelling and CGE modelling. The purpose of describing them is to highlight the relative strengths and weaknesses of such models rather than to determine which models are 'the best'. Put simply, the best model is the smallest simplest and most transparent model that sheds light on the link between the variables of most concern to the modellers.

Input output modelling and the use of multipliers

In Australia the Australian Bureau of Statistics (ABS) publish 'input-output' tables which show the linkages between all of the different sectors of the Australian economy. For example, the input output tables allow users to determine:

- The value of steel required by the car industry to make $1 million worth of cars.
- The value of wages paid by the car industry used to make $1 million worth of cars
- The value of cars purchased to provide $1 million worth of transport services,
- And, in turn, The increase in demand for steel associated with a $1 billion expansion in the transport industry.

The input-output tables are an invaluable resource for those interested in understanding the impact of a change in one industry on other 'upstream' and 'downstream' industries. The data required to calculate these input output tables is extensively used in the construction of the National Accounts.

The ABS also publishes a range of input-output 'multipliers' that are derived from the input output tables. In the words of the ABS:

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"Using input-output tables, multipliers can be calculated to provide a simple means of working out the flow on effects of a change in output in an industry on one or more of imports, income, employment or output in individual industries or in total. The multipliers can show just the 'first-round' effects, or the aggregated effects once all secondary effects have flowed through the system." [2]

While the input output tables provide a comprehensive description of the financial interactions between disparate parts of the economy they, like all economic models, need to be used with caution. Some of the biggest limitations of the input output tables for analysts are spelt out by the ABS in and include:

- Relationships between output and input are assumed to be fixed and, in turn, do not allow for technological change or changes in the ratio of capital and labour used to produce a given value of output.
- All of the output of an industry is assumed to be identical with no differences in quality of features.
- There are no economies of scale.[3]

These and other limitations lead the ABS to conclude that:

"(multipliers) tend to overstate the potential impact of final demand stimulus. The overstatement is potentially more serious when large changes in demand and production are considered."[4]

And: *"The implicit assumption is that those taken into employment were previously unemployed and were previously consuming nothing. In reality, however, not all 'new' employment would be drawn from the ranks of the unemployed; and to the extent that it was, those previously unemployed would presumably have consumed out of income support measures and personal savings. Employment, output and income responses are therefore overstated by the multipliers for these additional reasons."[5]*

Input output tables, and the multipliers derived from them, can be a useful tool for estimating the strength of the linkages between industries and shed light on the relative employment intensity of a wide range of different economic activities. They provide a relatively quick and inexpensive means to estimate the likely impact of relatively small changes in a specific industry on demand for labour or raw materials.

However, the relative simplicity of applying input output multipliers should not be confused with the ease of interpreting the results. Consider the following paradox:

- Every industry in Australia creates demand for raw materials in other industries and, in turn, could argue that they are 'responsible' for creating 'indirect' jobs in addition to those employed in their industry alone.
- Every industry in Australia could commission economic consultants to estimate the 'total' number of direct and 'indirect' jobs

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[2] McLennan, W. ABS, *Information Paper Australian National Accounts Introduction to Input-Output Multipliers*, Cat. No.: 5246.0, Pp.4, at
<http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/FFD0BAE851EDCB8BCA2570C9007ECE04/$File/52460%20-%20Information%20Paper%20-%20Introduction%20to%20Input%20Output%20Multipliers.pdf>.

[3] McLennan, W. ABS.

[4] McLennan, W. ABS.

[5] McLennan, W. ABS. Pp. 24.

- According to the ABS across the entire Australian economy on average there are 4.9 jobs created directly for every million dollars spent (compared to 1.4 for mining). And for every million dollars spent there are 9.2 jobs created in total giving a multiplier of 1.87. Therefore, if there were 10 million people in the Australian workforce and each industry sought to estimate their direct and indirect contribution to employment then collectively their claims would add up to 18.7 million workers.

It is relatively easy to resolve this paradox. The purpose of the multipliers is to highlight the interactions between industries as money flows around the economy. Some of the output of the energy industry is used to create steel and some of the output of the steel industry is used by the energy industry.

- The ABS data on employment tells us about the relative employment in each industry.
- The ABS data on output tells us about the output of each industry.
- The ABS data from the input output tables tells us about the linkages between each industry.

But when individual industries start using the input output multipliers to claim credit for employment and output in other industries they are guilty of 'double counting'. That is, when the mining industry tries to take credit for the size of the construction industry there is no offsetting 'reduction' in the measured size of the construction industry.

Historically this attempt at double counting, an attempt typically designed to increase the apparent size and significance of an industry, has been relatively inconspicuous due to the simple fact that the technique was only used by small industries that needed to find a way to increase their relative status. That is, industries such as manufacturing or retail with large levels of employment have had no need to use multipliers to suggest they are large employers while small employers such as agriculture and mining typically have.

In recent years, however, the rapid growth of the mining industry combined with their determination to continue to rely on the multiplier effect to exaggerate their size, has highlighted the potential absurd results that can be derived from input output modelling.

Put simply, the whole point of the National Accounts is to remove the 'double counting' of production associated with the fact that the output of the grain industry is included in the output of the bread industry. The whole point of using multipliers, however, is to put this double counting back into the public perception of the size of the economy

Consider the following examples of the way that the mining industry repeatedly suggests that every job in mining creates an additional three or more jobs elsewhere in the economy.

The Australian Mines and Metals Association

Ironically, in a press release entitled 'Mining critics should address the hard facts' the Director of Australian Mines and Metals Association stated that "ABS statistics show 213,200 people are directly employed in mining, oil and gas operations in Australia, with an additional 639,600 indirect jobs created by the resource industry."[6] That is according to the AMMA the mining industry is responsible for creating an additional three jobs for every one mining job suggesting total employment attributable to mining would be 852,800 people.

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[6] AMMA (2011), Resource Industry Employer Group, 'Mining critics should address the hard facts', *Media Release,* September 8.

This is Our Story – a website sponsored by the Minerals Council of Australia and a range of other mining industry associations and related organisations including the CSIRO and University of Western Australia

On a website constructed by the mining industry with the sole purpose of telling 'their story' the mining industry make the claim that *"Across the nation mining employs 187,400 people directly, and a further 599,680 in support industries."[7]* That is, the website suggests that for every mining job 3.2 additional jobs are created suggesting total employment attributable to mining is 787,080.

University of Queensland – Coal and the Commonwealth report

A major report funded by Peabody Energy and published by the University of Queensland claims that:

> *"The Australian coal industry employs over 32,000 people and indirectly creates an additional 126,000 jobs in Queensland and New South Wales".[8]*

This ostensibly academic study actually suggests that the indirect employment multiplier is more than 3.9, which in turn implies that the coal mining sub category of the mining industry accounted for 158,000 jobs.

Commonwealth Department of Education, Employment and Workplace Relations – National Resources Sector Employment Taskforce 'Resourcing the Future Report"

This taskforce was established by the Commonwealth Government in 2009 and in 2011 the then Minister for Skills and Jobs, Senator Chris Evans accepted all 31 of the recommendations of the taskforce as set out in the 'Resourcing the Future' report.[9] The executive summary of this report claims that *"Each additional job in the resources sector may lead to a further one to three jobs in other industries, with the employment effect tending to be higher in regional centres where the resources sector is a major employer and there are readily available job seekers."*

While the authors concede the existence of a wide margin of error for the indirect employment multiplier for mining (between 1 and 3) it is interesting to note that while the multiplier claim is made in the executive summary of the report the body of the report does not appear to provide any basis for its inclusion in the summary. Interestingly, the whole report is prefaced with the warning that *"The Australian Government and the National Resources Sector Employment Taskforce accept no responsibility for the accuracy or completeness of the contents and accept no liability in respect of the material contained in the report."*

So what is the indirect employment multiplier for the mining industry?

When asked directly whether the ABS published had estimated that the indirect employment multiplier was three the Assistant Statistician at ABS, Bjorn Jarvis, responding on behalf of

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[7] See the 'This is our Story' website mineral Council of Australia 2011) supported by a wide range of mining organisations and companies, at <http://www.thisisourstory.com.au>

[8] Knights, P and Hoods, M (Eds) 2009, 'Coal and the Commonwealth- The greatness of an Australian resource', The University of Queensland.

[9] DEEWR DEEWR (2010)' Resourcing the future national resource sector employment task force report', at <http://www.deewr.gov.au/Skills/Programs/National/nrset/Documents/FinalReport.pdf>

Brian Pink, the Australian Statistician, stated *"I can confirm that the ABS has not measured the number of indirect jobs created by mining, oil and gas operations."*[10]

While the ABS has not measured the number of indirect jobs created by mining it is possible, using the ABS input output tables to derive an indirect employment multiplier for the mining, oil and gas industry of 2.4 (that is, 2.52/1.04: see Table 1). However, leaving aside the reasons that ABS suggest such an estimate is likely to overstate the size of the multiplier, it is important to contextualise this figure in order to understand how misleading some claims based on multiplier analysis can be. For example, while every $1 million spent on mining creates 3.56 direct and indirect jobs, $1 million spent on health care creates 9.95 direct jobs. That is, even if the multipliers are ignored an investment in health care of $41 million would create twice as many direct jobs as the direct and indirect jobs associated with an investment in mining of the same size.

Table 1: Number of full time equivalent jobs per million dollars of output, 2007-08

Industry	Direct employment per $m output	Indirect employment per $m output	Total employment per $m output
All Mining	1.04	2.52	3.56

Source: ABS (2011) Australian national accounts: Input-output tables – Electronic publication, 2007-08 Final, Cat no 5209.0.55.001, 25 October.

Put another way, those who rely on input output models to assert the job creating potential of mining should be asked to explain why every million spent in the mining industry should not be interpreted as 'costing' jobs in other more employment intensive sectors. Indeed, those who rely on the input output multipliers to assert the job creating potential of the mining, or any other, industry should also be asked whether they agree that the ABS data suggests that if a million dollars was diverted away from the mining industry and towards the health care industry far more jobs would be created.

This paper is not arguing that the mining industry does not create jobs in other industries, nor is it suggesting that all mining activity should be transferred to the community service sector. Rather, the objective of this paper is to simply make the point that it is easy to misuse simple multiplier analysis and, furthermore, that such misunderstanding appears to be becoming more widespread. Indeed, a recent survey conducted by the Australia Institute found that the Australian public believe that the number of people employed in the mining industry is more than 800 per cent higher than it actually is.

Limitations of input output analysis

As discussed above, one of the biggest limitations of the use of input output modelling is that it assumes that the ratio of labour, capital and raw materials are fixed and, in turn, impervious to either price increases or real resource constraints. That is, the original ratios of workers to machinery would remain unchanged in the input output tables even if increasing wages in the mining industry lead to substantial changes in the capital labour ratio.

Similarly, if a modeller was to use input output tables to determine the impact of a doubling of the size of mining output they would find that employment would double, regardless of the

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[10] Bjorn Jarvis, November 30, 2011.

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ability of the economy to provide twice as many suitably qualified employees at the wage rate that prevailed when the input output tables were constructed.

The rigidity of input output tables and their inability to conform to the most basic of economic assumptions about the role of price in the economy means that input output modelling should only be used to evaluate relative small changes in the economy.

For example, if Ford were to increase their output by 10 per cent then, given that such an expansion would be unlikely to have a significant impact on either the price of steel or the local price of labour. For this reason, the use of input output tables, based as they are on the existing price relativities, would likely yield meaningful insight into the likely increase in employment and demand for steel.

Alternatively, if the mining industry were to double in size in a short period of time then the construction boom associated with such an expansion would likely have a major impact on the price of steel, concrete, excavation machinery and skilled labour. In turn, it would be virtually meaningless to rely on the relative factor shares that existed before the boom to estimate the likely impact of such a boom. Further, the doubling in size of an industry is likely to create price pressures and labour market constraints for other industries, pressures which are ignored when input output tables are used to evaluate the impact of the expansion. Finally, a major boom in one industry is likely to lead to significant shifts in the structure of the economy which in turn will create a wide range of macroeconomic pressures, including upward pressure on the exchange rate, wages rates, inflation and interest rates. Again, none of these effects will be captured in estimates of 'job creation' derived from input output tables.

To conclude, input output tables are useful for conducting what economists call 'partial equilibrium analysis', that is, analysis of a change in one sector that is sufficiently small that it is considered safe to assume that 'all other things remain equal'. For that reason, when big changes that effect other industries are being considered it is necessary to rely on some form of macroeconomic model which explicitly considers the way that industries both respond to changes in relative prices are competitors with each other for scarce resources.

What is a CGE macroeconomic model?

The most commonly used models for evaluating major policy decisions are Computable General Equilibrium, or CGE models. These models are an extension of the input-output type models described above with one of the most significant differences being that CGE models allow for prices to change the relative use of different factors of production in the production of a good or service. That is, while input-output models are an attempt to explain how much wheat, energy, labour and capital is used to make bread a CGE model might be used to estimate the impact of a wage rise on the amount of labour used in bread production.

CGE models are built on the input output tables described above but combine these models with a wide range of equations designed to simulate the structural and behavioural relationships that shape economic activity. In addition to the data from the input output tables on the linkages between different industries, CGE models need to include estimates of the 'elasticity', or sensitivity, of a wide range of variables. For example, the modeller has to make assumptions to answer questions such as:

- When the exchange rate rises will there be a big reduction in exports or a small reduction in exports?
- When the wage rate rises will there be a big reduction in the demand for labour or a small reduction?
- When the tax rate rises will there be a big reduction in the willingness of workers to supply labour or a small reduction?

It is important to remember that if a model assumes that a small increase in tax will lead to a large reduction in the willingness of people to work then the model will inevitably 'find' that a small increase in tax will lead to a large reduction in the willingness of people to work. It is, therefore, essential that those who are using macroeconomic modelling results are fully aware of what assumptions have been made by the modeller otherwise models can simply become a vehicle for converting assumptions into conclusions.

One of the most important, and least understood, features of CGE models is that they assume that, in the long run, the economy will be in full employment and that the path that the economy follows has no impact on its long run destination. It is hard to overstate the significance of this assumption, put simply, it means that if the economy experiences a deep policy induced recession the model assumes that the recession will CAUSE a sufficiently strong recovery that the final destination is no different from what it been had no such recession occurred. In other words, CGE models assume that there was no long run harm from the high interest rates that caused the 'recession we had to have'.

While such an assertion may seem surprising, it is freely admitted by those who have built the most common CGE models used in Australia. For example, in their description of Treasury's TRYM model, Treasury (1996) say that their model is:

> *"broadly new Keynesian in its dynamic structure but with an equilibrating long run. Activity is demand determined in the short run but supply determined in the long run…The model will eventually return to a supply determined equilibrium growth path in the absence of demand or other shocks."* [11]

What this means is that while the model allows for some real world economic volatility in the short run (the Keynesian dynamic structure) this 'noise' is ignored when determining the long run path of economic development (the supply determined equilibrium growth path).

This point is conceded quite explicitly by Treasury (1996) when they state that:

> *"the point of interest here is not that equilibrium exists in TRYM (which is largely by construction) but how long it takes to get there. Typically it will take up to a decade for demand oscillation to dampen down to the steady state path"* [12]

Of course it is not just the Treasury model that is built on the assumption that the long run is independent of events in the short run. For example, in describing the RBA model Beechey, Bharucha, Cagliarnini, Gruen and Thompson (2002) state:

> *"The model is predominantly empirically based and designed to be consistent with the behavior of the main macroeconomic aggregates in the Australian economy over the past fifteen years…the model also has a well defined steady state to which it converges in the longer run, with properties that accord, in crucial respects, with our theoretical expectations."* [13]

To decode again, the economy is assumed to 'converge' towards a 'well defined steady state' in the longer run. Put another way, the modelling starts with the answer for what the

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[11] Treasury (1996), The Macroeconomics of the TRYM Model of the Australian Economy, Canberra, AGPS, Pp.1.20

[12] Treasury (1996), The Macroeconomics of the TRYM Model of the Australian Economy, Canberra, AGPS, Pp.2.15.

[13] Beechey, M., Bharucha, N., Cagliarnini, A., Gruen, D., and Thompson, D. (2002), 'A Small model of the Australian Macroeconomy', *Research Discussion Paper*, 2000-05, Reserve Bank of Australia, Sydney.

long run level of GDP will be and then tries to plot the course that the economy will follow from where it currently is to where they know it will end up.

Those theoretical expectations referred to by Beechey et al. are those of neoclassical growth theory, based primarily on the work of Solow (1956) and Swan (1956). In an early survey of the neoclassical growth literature, Hahn and Matthews (1964) summarized the long run properties of the model as follows (p. 790)

> *"In its basic form the neo-classical model depends on the assumption that it is always possible and consistent with equilibrium that investment should be undertaken of an amount equal to full employment savings. The mechanism that ensures this is, as a rule, not specified. Most neo-classical writers have in mind some financial mechanism."*

The problem is, however, that even Robert Solow, the father of modern neo-classical growth theory has conceded that given that his theoretical model of economic growth was based on the existence of perpetual full employment that it was a poor foundation for economic models concerned with the impact of policy or event on unemployment. Indeed Solow himself has stated:

> *"The economy may eventually return to an equilibrium path, perhaps because 'prices are flexible in the long run' as we keep telling ourselves. If and when it does it will not return to the continuation of the equilibrium path it was on before it slipped off."[14]*

Macroeconomic models are explicitly designed to overcome the lack of interaction between industries and factors of production that input output modelling ignores. It is, therefore, essential for macroeconomic modellers to make assumptions about the nature and strength of those relationships. It is not the process of making assumptions that is problematic, but the process of concealing them.

Macroeconomic models can play an important role in evaluating policy options when the assumptions they make are realistically determined and explicitly revealed. But, as shown below, macroeconomic modelling can easily be used by those with the means to use them to present assumptions as conclusions or to make the trivial seem enormous.

The importance of context

There are more than 22 million Australians, more than 11 million of whom work to produce a GDP of more than $1.3 trillion per year. It is this context that claims that a policy might create or cost 10,000 jobs should be evaluated. As highlighted recently by Professor Bruce Chapman, however, this is often not the case.

In a recent paper published by the Australia Institute Professor Chapman sought to contextualise the claim that the introduction of a carbon price would result in a 'loss' of 23,510 jobs. The paper found that:

- The 'job loss' figures did not refer to any absolute reduction in employment but rather to a reduction in the rate of job growth in selected industries
- If 23,510 jobs were lost in one year the unemployment rate would have risen from 4.88 per cent to 5.08 per cent.
- In fact, the 23,510 job 'loss' figure did not refer to a one year period but rather a ten year period, suggesting an annual reduction in employment of 2,350 suggesting an increase, all other things equal, in the unemployment rate of 0.016

[14] (p. 312) Solow 'Growth theory and after' American Economic Review, vol 78(3) June 1988, pp. 312.307-17

- When the gross flows in the labour market are taken into account we learn that around 370,000 people move into and out of the labour force each month. The modelled impact of the carbon price would result in an additional 196 people per month leaving the labour force.[15]

It is clear that even when well designed economic models are used skilfully to address the kind of policy questions the model was designed to address it is clear that the results can easily be used to confuse, or even mislead, policy makers when they are not presented in a meaningful context.

Comparing the CGE modelling of mining to the input output modelling

One way to highlight the nature and extent of the disparity between CGE and input output multiplier modelling is to compare the conclusions of the two different approaches when considering the same industry.

As discussed above, the mining industry regularly claims that for every job created in mining three or more jobs are created in other industries. Leaving aside the fact that the actual figure is likely to be significantly lower than that, an important limitation of the use of input output modelling is the implicit assumption built into input output modelling is that the 'flow on' effects of increased economic activity in one sector are always positive for industries. CGE modelling typically shows that the opposite is typically the case.

For example, the proponents of one of the world's largest coal mines, the China First mine in Queensland commissioned CGE modelling in order to make their case for the economic benefits that would flow from its approval. While the conclusion of the modelling was that the mine would lead to 6,000 new jobs and increased employment across both Queensland and Australia the results are far less positive for other sectors of the economy than that suggested by the input output modelling.

For example, according to the proponents of the China First mine if it were to proceed more than 3,000 jobs would be lost in other sectors. Manufacturing jobs were estimated to decline by 2,215 in Queensland alone. The CGE modellers go on to state:

> "of note, the manufacturing sector is estimated to record a considerable decline in overall industry output during operation…it is anticipated the manufacturing sector will be one of the hardest hit sectors in terms of the reallocation and draw of labour to the China First Project given the relatively similar skills sets employed...further, the export of $4.6 billion of coal will likely place some upward pressure on Australia's exchange rate, which may impact on the global competitiveness of manufacturing goods produced in Australia." [16]

That is, while input output modelling suggests that an expansion of an industry such as mining will only have beneficial impacts on other industries CGE modelling finds the opposite. This disparity is explained by the fact that input output modelling assumes that 'all other things remain equal' and, in turn, that an increase in activity in one sector simply increases demand for goods and services from other industries. In CGE modelling, however, the impact of an increase in activity in one sector is assumed to alter the prices of goods and

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[15] Chapman, B and Lounkaew, K 2011. 'How many jobs is 23, 510 really? Recasting the mining job loss debate'. [Online] The Australia Institute, Technical Brief No 9, June. [Cited: 30 August 2011] <https://wwwitai.org.au/index.php?q=node%F19&pubid=862&act=display>.

[16] Denniss, R 2011. 'An analysis of the economic impacts of the China First mine'. [Online] 16 December. <https://www.tai.org.au/index.php?q=node%2F19&pubid=939&act=display>

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services in other industries as well as impacting on exchange rates, interest rates and other macroeconomic variables.

In summary, while those claiming to use input output models find that every new mining job creates three additional jobs in other industries those using CGE modelling suggest that for every two jobs created in mining one job is lost elsewhere in the economy. The choice of modelling approach therefore has a big impact on the conclusions that can be drawn.

Comparing the poker machine industry claims to the mining industry claims

The gambling industry has recently argued that the introduction of mandatory pre-commitment technology would cost up to $5 billion and lead to a substantial loss of jobs in Australian hotels.

While the $5 billion estimate of the cost of reform has been described as 'fanciful' by the author, the economic logic, or lack thereof, highlights the confused way that economic modelling is now being used in Australian policy debates.

If the gambling industry's estimate of $5 billion to replace and repair Australia's 200,000 poker machines was in any way accurate then the potential to create jobs, both directly and indirectly, would be significant. Indeed, The Australia Institute used the ABS input output multipliers to estimate that such a significant investment in new equipment would create around 23,000 direct and indirect jobs.

Of course, given the discussion above, it is obvious that the actual impact of poker machine reform would be more modest, and more complicated, than the 23,000 jobs estimate suggests not least because of the overblown nature of the gambling industry's $5 billion cost estimate.

The objective of including this example is to highlight the inconsistent way in which industry groups use economic modelling to build the case for their preferred policy agenda. The mining industry is usually quick to exaggerate the likely indirect job creation associated with its expenditure while the poker machine industry pretended that no such effects exist.

Conclusion

The most common problem with the way that economic modelling used is Australian policy debates in Australia is when good modelling is used out of context to suggest that the case for a particular policy position is stronger than the modelling actually suggests.

For example, macroeconomic modelling results for the whole economy are often used to conceal significant impacts for particular industries or particular regions. When this is the case we are encouraged, both by the people who commissioned and conducted the modelling, to focus on the 'national interest' and the big picture.

However, industry specific modelling is often used to suggest the exact opposite, namely, that what is good or bad for a particular region or industry is, by implication, good or bad for the country more generally. For example, such microeconomic modeling might show that a policy will reduce the number of people employed in a particular industry while macroeconomic modelling might show that the same policy change would lead to an increase in employment nation-wide.

Again, the point being made here is that the act of selecting what kind of model is to be used to evaluate a policy proposal will, inevitably, have an impact on the way that the results will be framed and perceived.

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