Is technological unemployment in Australia a reason for concern?

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Technological unemployment refers to the loss of jobs associated with technological change.

OECD (1994), The OECD Jobs Study: Facts, Analysis, Strategies, Paris.

This study identified pressures arising from technological change and global competition. Structural changes in the economy have differentially impacted on men and women, and on particular locations.

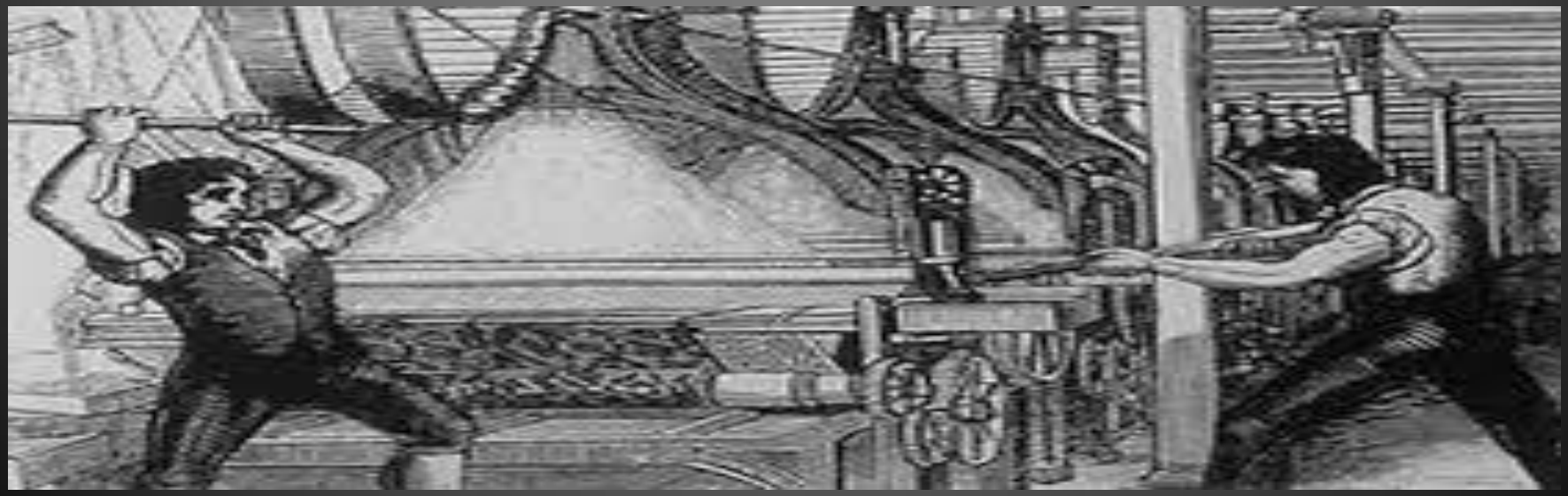
This is far from being a new phenomenon.

Luddite

The Luddites were 19th-century English textile workers who protested against newly developed labour-economising technologies, primarily between 1811 and 1816.

The stocking frames, spinning frames and power looms introduced during the Industrial Revolution threatened to replace them with less-skilled, low-wage labourers, leaving them without work.

14 convicted Luddites were executed at York Castle in England on 16th January 1813

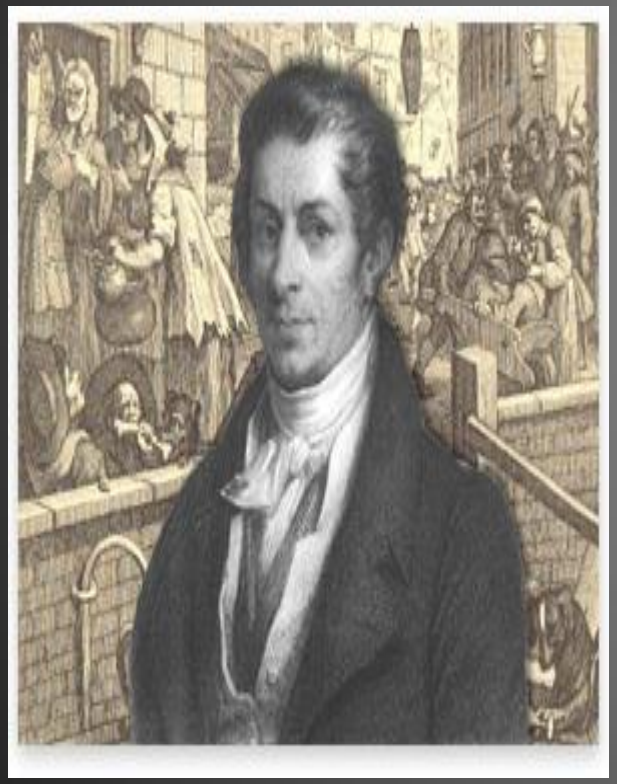


David Ricardo-British Economist (1772–1823)

He was convinced that the substitution of machinery for human labour is often very injurious to the interests of the class of labourers.

Ricardo (1821, chapter 31, 'On Machinery,' in the third edition of Principles)

Jean-Baptiste Say-French economist (1767–1832)



Jean-Baptiste Say's response to Ricardo was that no one would introduce machinery if they were going to reduce the amount of product.

Say's Law states that supply creates its own demand, and any displaced workers would automatically find work elsewhere once the market had had time to adjust. Say(1834, A Treatise on Political Economy)

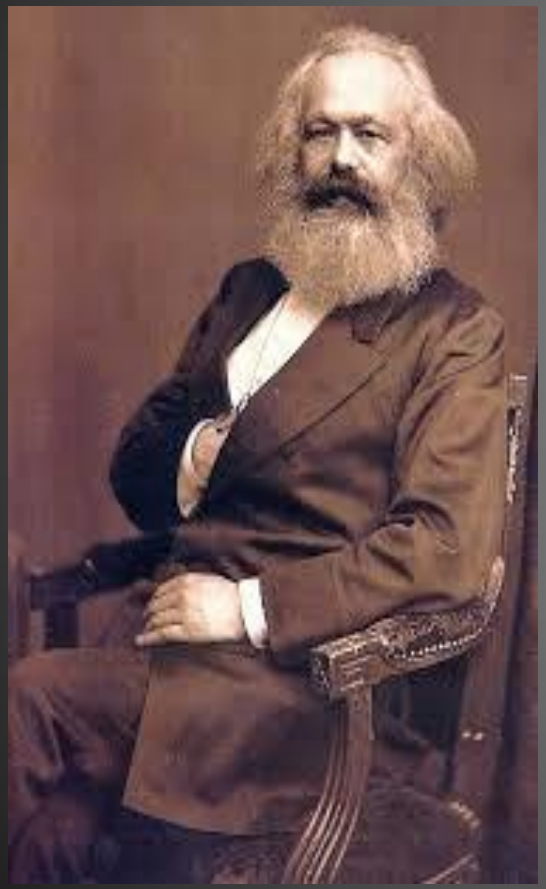
John McCulloch-Scottish economist (1789-1864)

"theory of compensation"

According to his approach, all technically displaced labour will necessarily be absorbed in the making of the machines themselves.

This approach rests on the idea that, under perfect competition, innovations result in price reductions and an expansion of output. (1825, Principles of Political Economy)

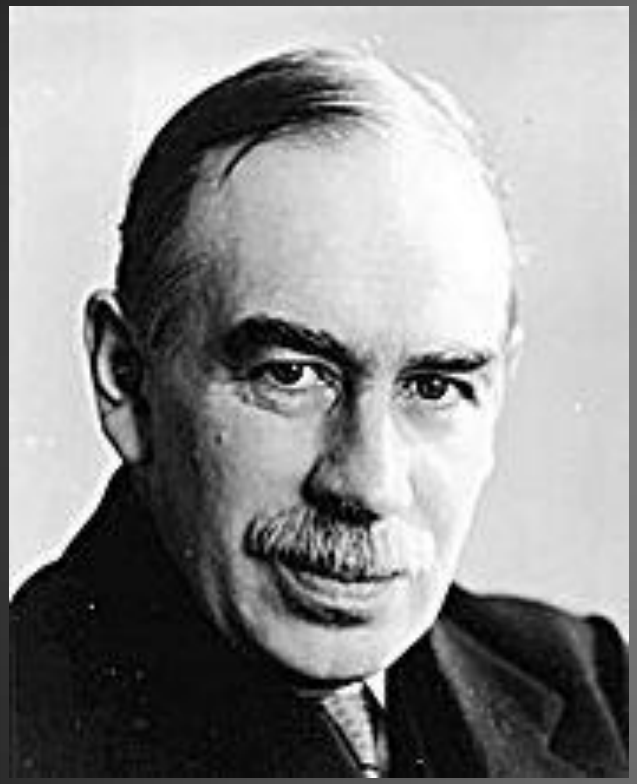
Karl Marx-German economist (1818 – 1883)



The introduction of machinery may increase employment in other industries, yet this expansion has nothing in common with the so-called theory of compensation.

The production of greater surplus-value leads to greater wealth of the ruling classes.(1867, Capital, Volume I)

John Maynard Keynes-American economist (1883 - 1946)



We are suffering just now from a bad attack of economic pessimism. He imagined a middle way between revolution and stagnation that would leave the future grandchildren a great deal richer than their grandparents.

But the path is not without dangers.

This "new disease", "technological unemployment is due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour". (1963, Essays in Persuasion)

However, he also was thinking about a future of leisure and abundance centred on a fifteen hour work week.

Joseph Stiglitz-American economist and awarded the Nobel Memorial Prize in Economic Sciences (2001)

In the United States and many other advanced industrial countries, the losers are those at the bottom of the income distribution.

It is then innovation can contribute to growing inequality.

In this situation, whether societal welfare is increased depends on how one weighs the benefits to the relatively rich against the losses to the relatively poor.

(2014, Unemployment and Innovation)

Recent Studies

America

Brynjolfsson, E., & McAfee, A. (2014). The second machine age: work, progress, and prosperity in a time of brilliant technologies. WW Norton & Company.

- General purpose computers are directly relevant not only to the 60% of the labour force involved in information processing tasks but also to more and more of the remaining 40%.

- Computers are now demonstrating skills and abilities that used to belong exclusively to human workers. This trend will only accelerate in the future.

Frey, C. B., & Osborne, M. A. (2013). The future of employment: how susceptible are jobs to computerisation. Retrieved September, 7, 2013.

- According to there estimates, about 47% of total US employment is at risk.

Europe

Pajarinen, M., & Rouvinen, P. (2014). Computerization threatens one third of Finnish employment. ETLA Brief, 22, 13.

- We find that one third of Finnish employment is highly susceptible to computerisation in the next decade or two. Low wage and low skill occupations appear more threatened. Service jobs are relatively more sheltered than manufacturing jobs.

Feldmann, H. (2013). Technological unemployment in industrial countries. Journal of Evolutionary Economics, 23(5), 1099-1126.

- He found that technological progress may increase unemployment, at least during a transition period, however no long term affects.

Australia

Fraser, J. (2015). Australia's economic policy challenges: Address to the Committee for Economic Development of Australia (CEDA).

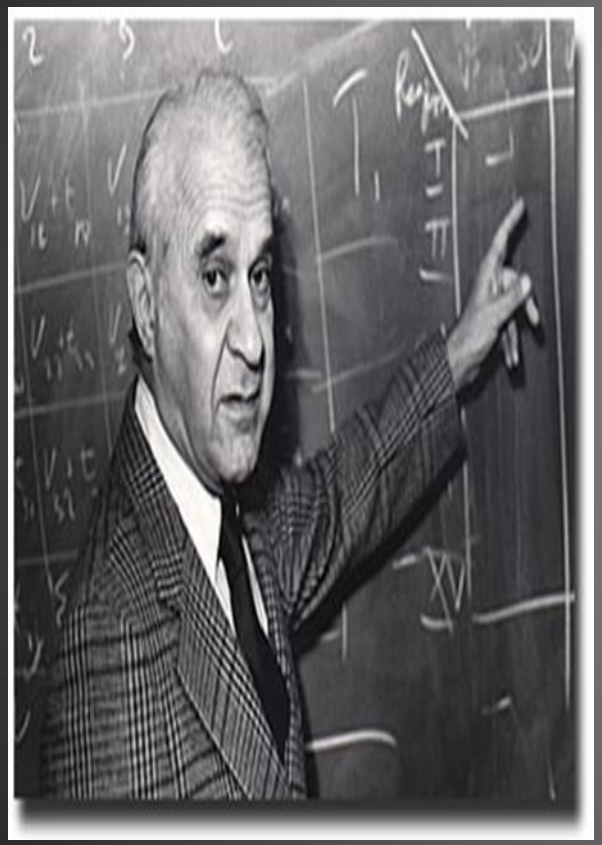
- The results conducted for this report suggests almost five million jobs face being replaced by automation in the next decade or two.

Christine Lagarde (Australian)
Managing Director, International Monetary Fund

Lagarde, C. (2014). Innovation, Technology and the 21st Century Global Economy. Speech delivered at Stanford University, Stanford, CA, February.

- In the past, it was agricultural workers and then industrial workers in jeopardy. Today, even seasoned professionals can find themselves cast adrift on an unfamiliar ocean.

Wassily Leontief -Russian born economist 1906 –1999)



Leontief & Duchin developed an input-output model on The Impacts of Automation on Employment, 1963-2000.

According to their model, the intensive use of automation over the next 20 years from 2000 will make it possible to conserve only 10 per cent of the labour that would have been required to produce the same number of goods. (1984, The Impacts of Automation on Employment, 1963-2000)

The Central West Region, New South Wales and Australia

Source: Prepared by Andy Fischer, 2014, University of Tasmania, Australia using ArcGIS.

The Input-Output Model

The main purpose of the Input-Output model is to provide a picture of an economy in a very structurally detailed way, at a particular point of time.

The tables are constructed using the RAS method for a national table and GRIT method at the state and regional level and built with data gathered from the ABS (G.R. West, 1993).

The RAS method is named after the economist Richard Stone and is applied for balancing the columns and rows of Input-Output tables for updating or revising purposes (Stone & Brown, 1965).

The GRIT (Generation of Regional Input-Output Tables) method is used to generate an approximation of the lower-order transactions table from the current (parent being national or state constructed using the RAS method) higher order transactions table (West & Jackson, 2005).

Input-Output Analysis

The matrix includes all the transactions (both sales and purchases) which occurred during the time interval of, usually, one financial year, and this provides a foundation for the comprehensive analysis of the sectorial linkages within an economy. For instance, if there is a change in the purchasing or sales pattern of any industry, the flow-on effects to every other industry can then be calculated (Leontief, 1936).

With the use of this matrix, we were able to estimate the gross output, employment multipliers, output and income elasticities on employment.

A few of the key benefits of using input-output models is the refinement of detail available at a disaggregated industrial level, the relative ease of application, particularly for sub-regional levels, and the ability to model industrial economic impacts both quickly and efficiently (Loveridge 2004).

Limitations

These are the limitations that underpin the Input-Output model and they are:

- Constant prices
- Fixed technology
- Fixed import shares
- Constant labour productivity within sectors
- No constraints on supplies of factor inputs

Location quotient (LQ) is a valuable way of quantifying how concentrated a particular industry, cluster, occupation, or demographic group is in a region as compared to the nation.

The use of location quotients is imperative in addressing the substitution of inputs between industries and also identifying goods that are imports and exports (Flegg & Webber, 1997).

The analysis undertaken in this study is over a period of time, so all these limitations are addressed.

Calculations

Gross output

Gross output is principally a measure of an industry's sales or receipts, which includes sales to final users in the economy (GDP) or sales to other industries (intermediate inputs).

Employment

The total number of people gainfully employed or working.

Income

The monetary payment received for goods or services, or from other sources, as rents or investments.

Employment multiplier

The employment multiplier can be defined as the impact on the aggregate employment if the Gross Output in a sector increases by one unit. This impact can be measured separately by both production and consumption induced effects.

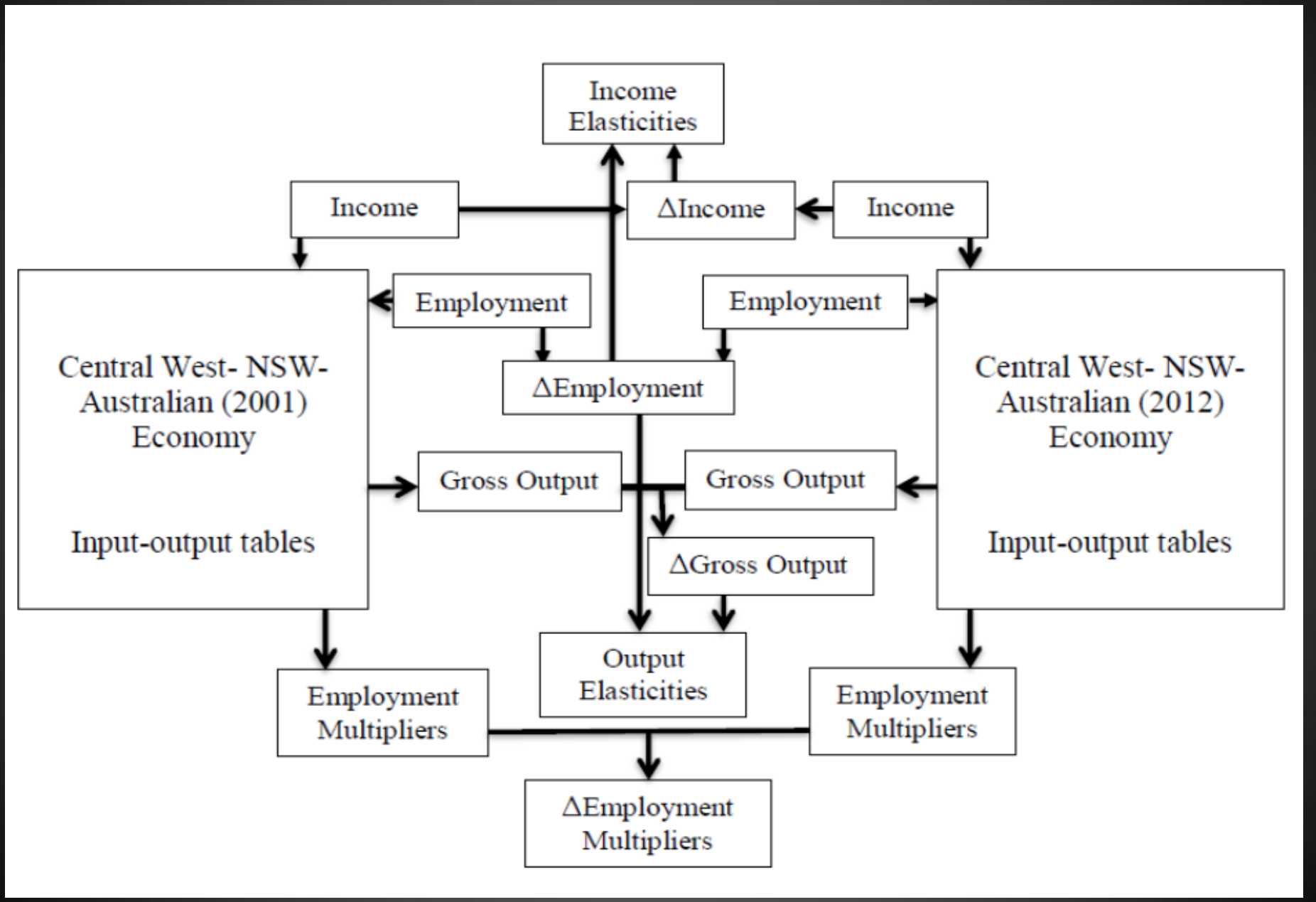
Output elasticity

The output elasticity measures the percentage change in aggregate employment in the economy resulting from a one per cent change in the Gross Output of a given sector.

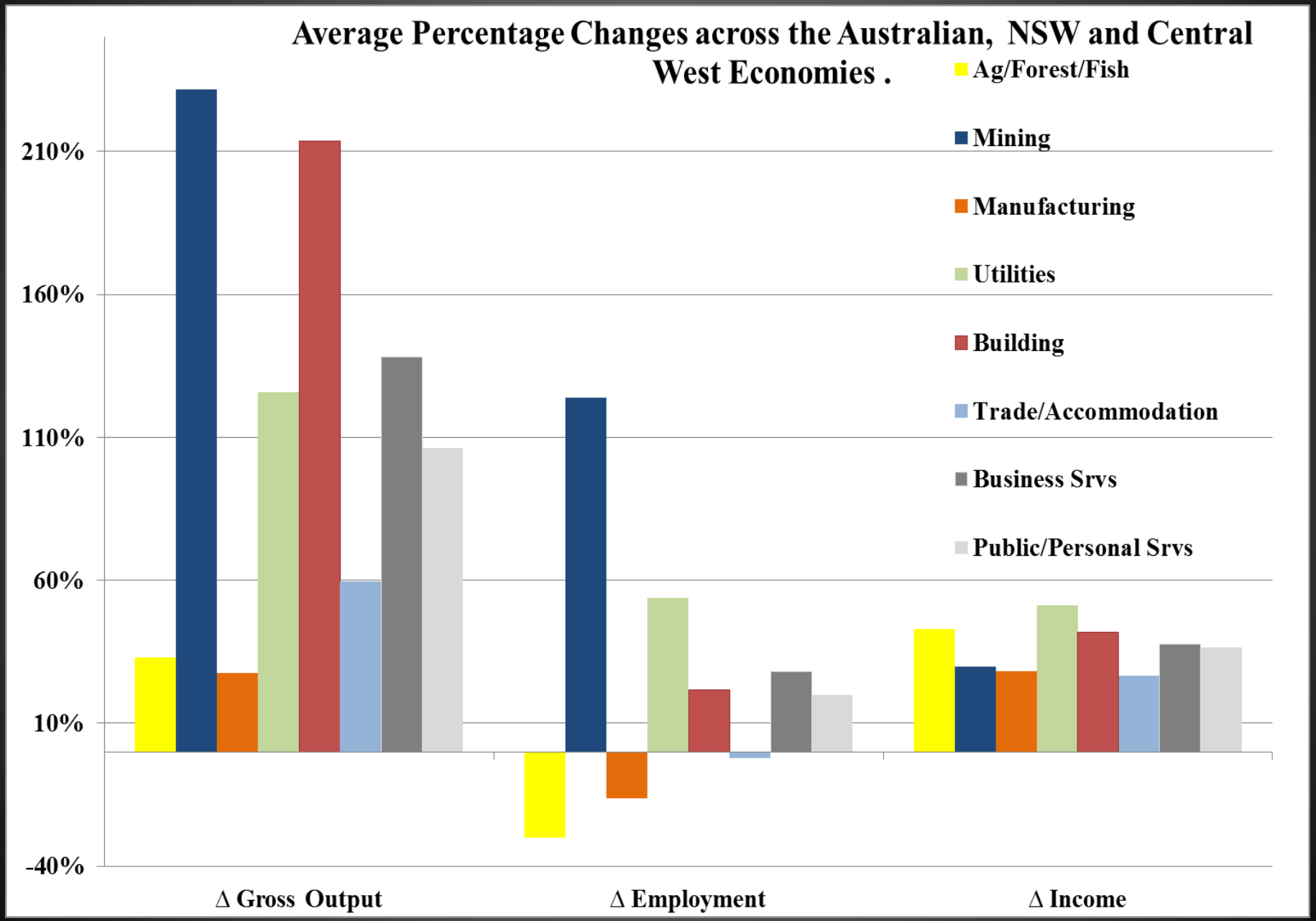
Income elasticity

The income elasticity measures the percentage change in aggregate employment in the economy resulting from a one per cent change in the income of a given sector.

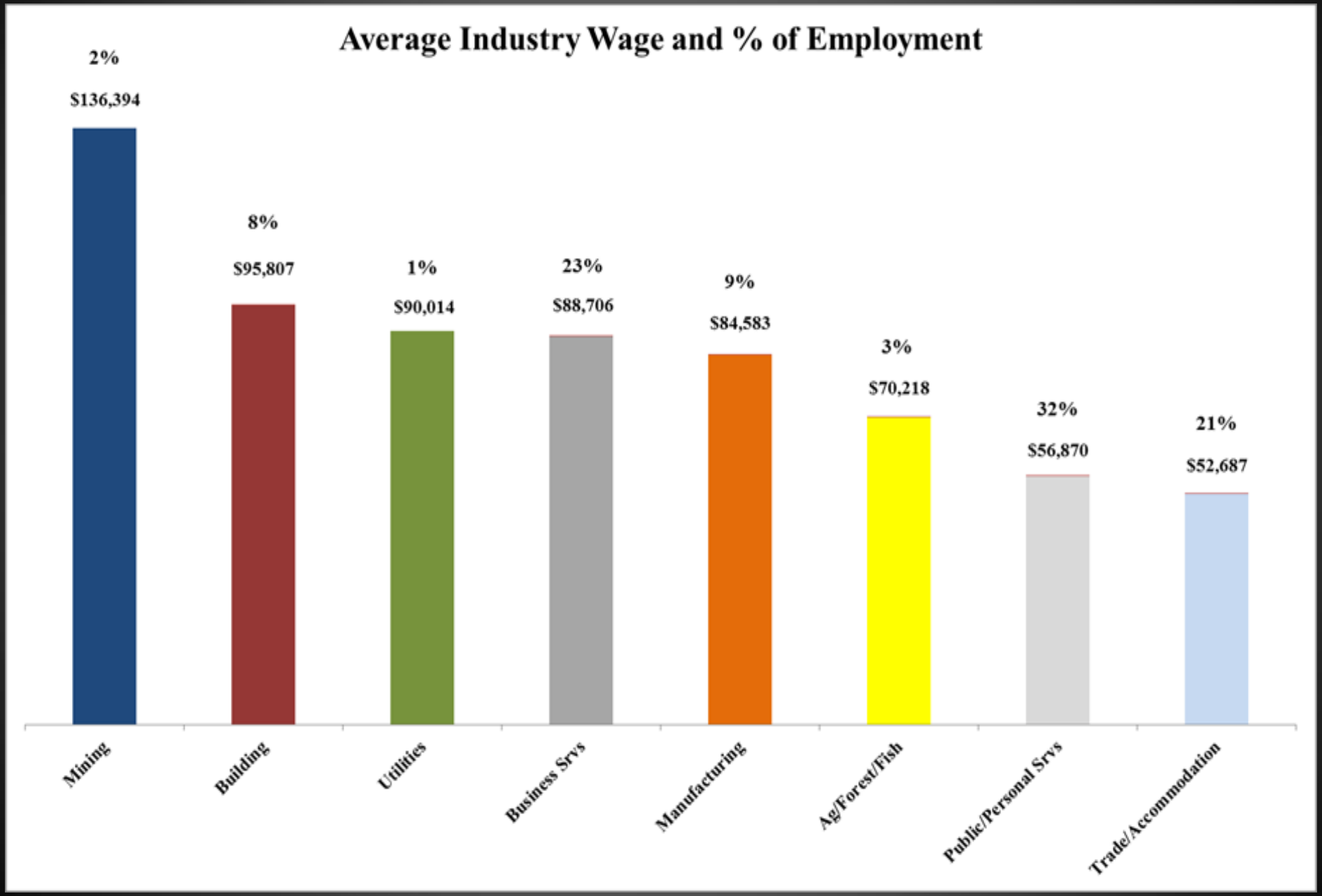
A Conceptual framework of the model (2001-2012)



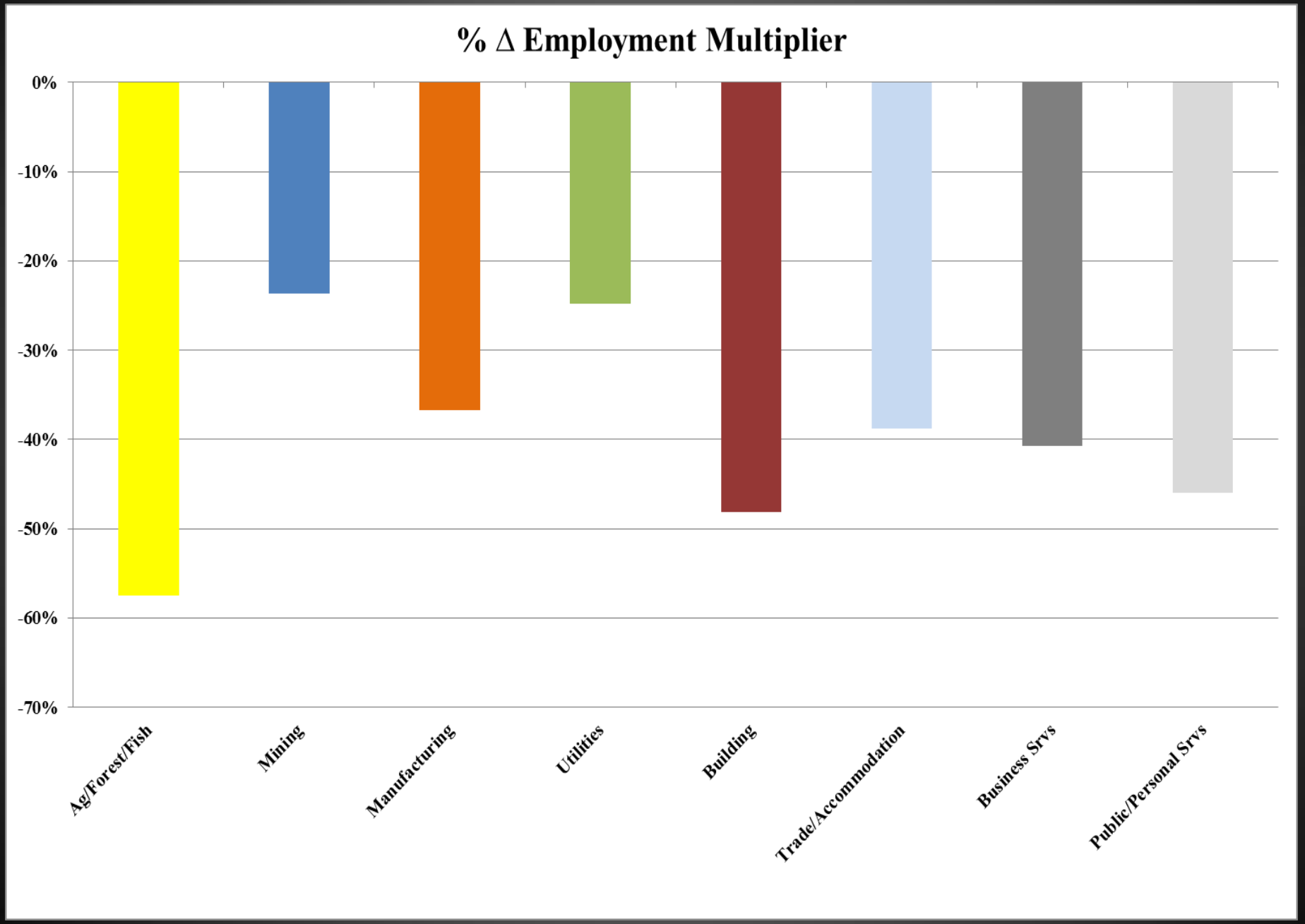
2001-2012


Average Percentage Changes across the Australian, NSW and Central West Economies .
Ag/Forest/Fish
Mining
Manufacturing
Utilities
Building
Trade/Accommodation
Business Srvs
Public/Personal Srvs
210%
160%
110%
60%
10%
-40%
Δ Gross Output
Δ Employment
Δ Income

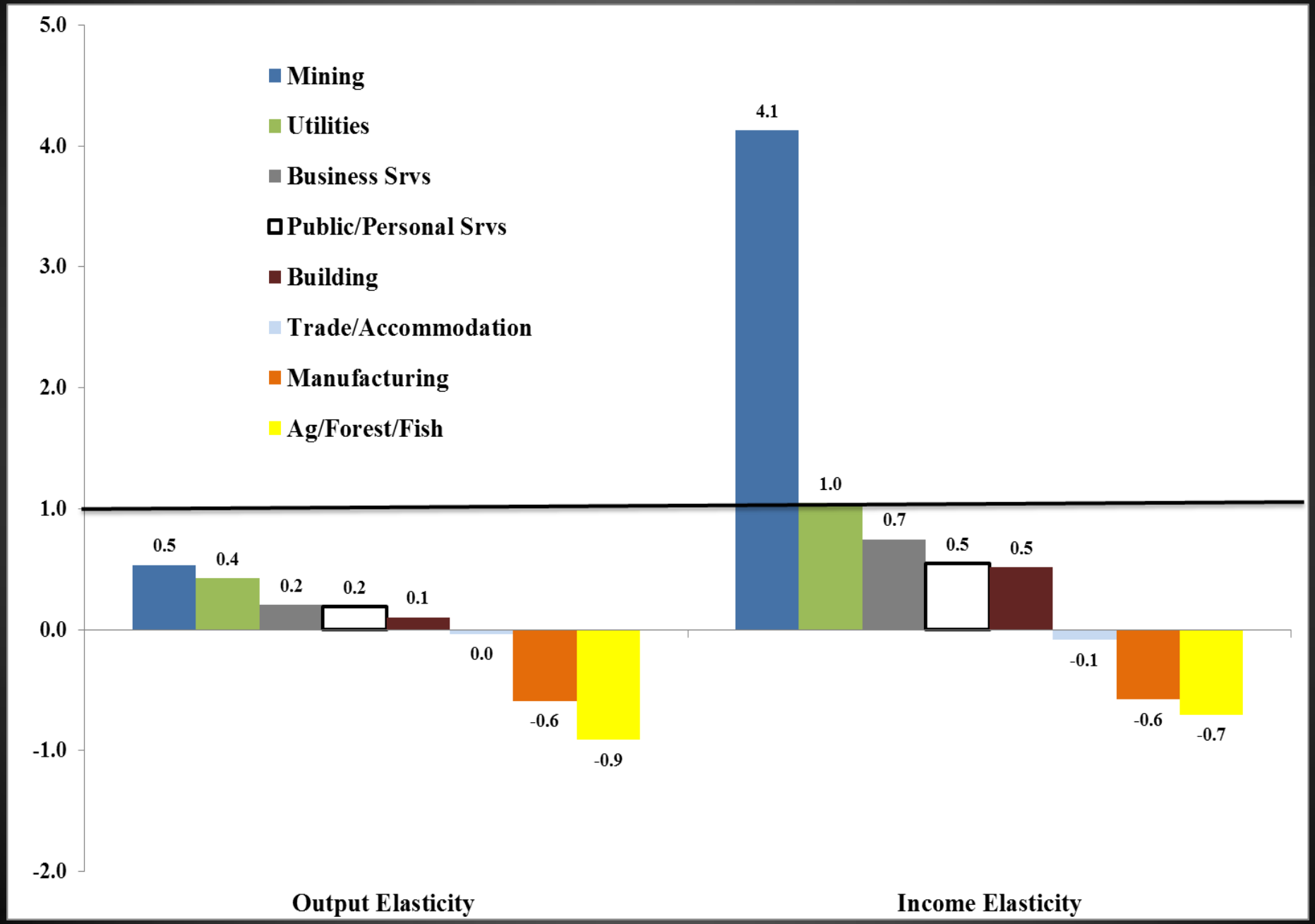
2012


Average Industry Wage and % of Employment
2%
$136,394
8%
$95,807
1%
$90,014
23%
$88,706
9%
$84,583
3%
$70,218
32%
$56,870
21%
$52,687
Mining
Building
Utilities
Business Srvs
Manufacturing
Ag/Forest/Fish
Public/Personal Srvs
Trade/Accommodation

2001-2012


% Δ Employment Multiplier
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
Ag/Forest/Fish
Mining
Manufacturing
Utilities
Building
Trade/Accommodation
Business Srvs
Public/Personal Srvs

2001-2012


5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
Mining
Utilities
Business Srvs
Public/Personal Srvs
Building
Trade/Accommodation
Manufacturing
Ag/Forest/Fish
0.5
0.4
0.2
0.2
0.1
0.0
-0.6
-0.9
4.1
1.0
0.7
0.5
0.5
-0.1
-0.6
-0.7
Output Elasticity
Income Elasticity

Mining

The most notable increases across the sectors were the Mining sectors with a greater than 200% increase in output, this also contributed to 100% increase in employment during the period.

It is noted that the mining sector is by far the highest paid annual wage however it only represents 2% of Australia's employment .

The elasticities suggest that mining labour is only mildly responsive to output and vastly responsive to wage increases.

This indicates that the mining industry has gone through an expansion stage. So in order to expand, they have needed the labour and were willing to pay for it at any cost.

This also means that labour in the mining industry is fluid and they will decrease labour just as fast as they employ or invest in Labour-saving technologies to save on production costs in the long-term.

They also have the least decease in the multiplier. However, the industry has gone through an expansion stage, so this could be skewed and could produce different results when this phase has finished.

Manufacturing, Agriculture, Forestry, Fishing, Trade and Accommodation

These were the least output-increasing sectors. Furthermore, their employment all decreased over the time indicating that the high wages paid by the mining industry has lured them away because they are the least paid sectors of the economy excluding the public services sector.

The manufacturing sector may be skewed high because of the Mineral processing sectors within that section of the economy.

The bottom four industries, excluding the public service sectors represent 33% of the nation's employment while the top three only represent 11%.This means that it is imperative to support this lower paid section of the economy rather than the top three sections of the economy.

Both the Output and Income elasticities were in negative territory and the lowest of all the industries. This means that labour in these sectors are the least driven by output or income and their labour is less fluid and more stable compared to the other sectors.

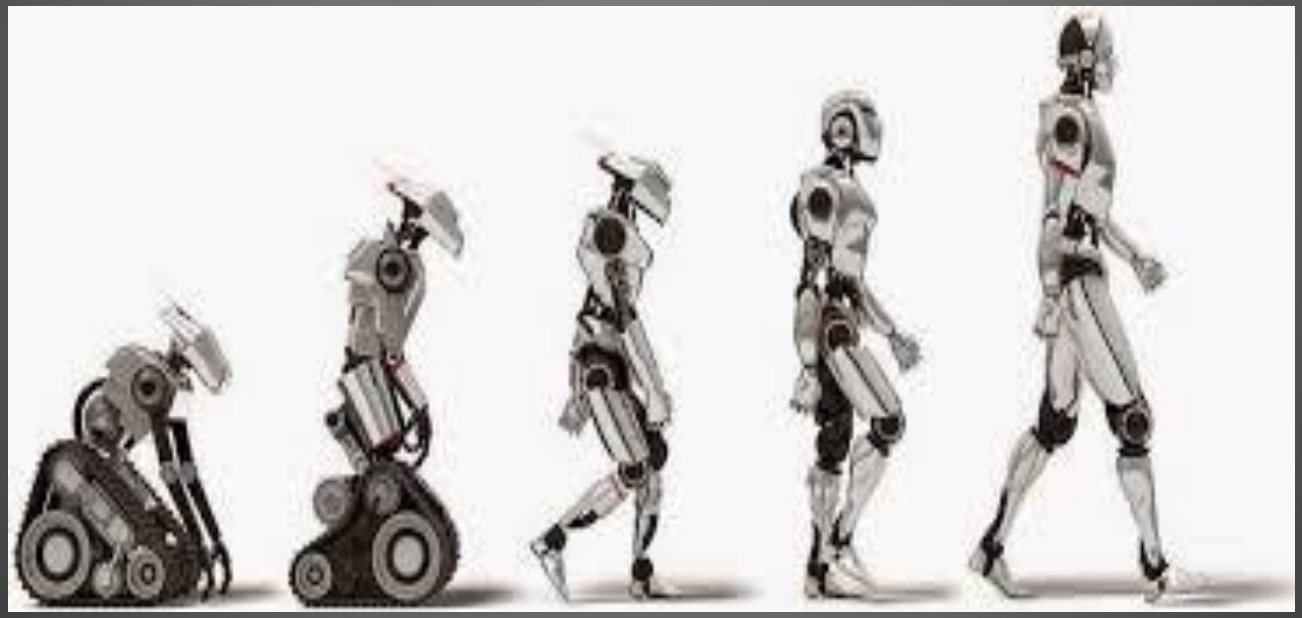
Given this is the case, then the results indicate that the Mining sector seems likely to be the first affected with the Manufacturing, Agriculture, Trade and Accommodation sectors least affected.

Only time will tell.

Driverless trucks

3d printers building homes

Advances in Robotic Technology



Documentary by Sam Vallely

Here

Is technological unemployment in Australia a reason for concern?

Indeed it is.

“Work saves us from three great evils: boredom, vice and need.” Voltaire, Candide, 1759.

Recommended Changes

Education-Science base nation.

- Funding to Educational institutions

Infrastructure-Better Transport

- Inland Rail link to Darwin

Fairness- inequality

- Policies that redistribute income across generations can ensure that a rise in robotic productivity benefits all generations.

Paul Krugman-American economist-Awarded Nobel Memorial Prize in Economic Sciences

"I can already hear conservatives shouting about the evils of "redistribution."

But what, exactly, would they propose instead?"

Krugman, P. (2013). Sympathy for the Luddites. New York Times, 13.

Not the end

Compensation theory include:

- By new machines. (The labour needed to build the new equipment that applied innovation requires.)
- By new investments. (Enabled by the cost savings-and therefore increased profits from the new technology.)
- By changes in wages. (lowering of wages, allowing more workers to be re-employed, or workers may enjoy wage increases. This leads to increased spending, which in turn encourages job creation)
- By lower prices. (Which then lead to more demand, and therefore more employment.)
- By new products. (Where innovation directly creates new jobs.)

Formulas

By dividing the elements of the transactions table *tij* by their respective total output levels *xj*, the direct coefficients matrix is obtained, where *aij* = *tij/xj* are the direct coefficients. This system of simultaneous equations is usually written in matrix format as:

$AX + Y = X$ (1)

where A = *aij* is the matrix of direct coefficients, X is the column vector of sector total outputs and Y is the column vector of aggregate of Gross Output. From equation (1), we can see that, for a given direct coefficient matrix, it is possible to solve the set of synchronized equations to find the new sector production levels X which will be required to satisfy the actual change in the levels of the sectors Output Y. Readjusting equation (1) gives:

$(I - A)X = Y$ or $X = (I - A)^{-1}Y$ (2)

where (I − A)−1 is termed the total requirements table, Leontief inverse matrix represents the direct and indirect effect on the Gross Output of each sector in response to a unit change in the Output of each sector. It is equations (1) and (2) which provide the basis of the Input-Output model.

The employment multiplier can be defined as the impact on the aggregate employment if the Gross Output in sector *j* increases by one unit. The employment multiplier for sector *j* is defined as follows:

$$E_j^m = \sum_{i=1}^{n} (l_i | x_i)\, b_{ij} \quad (3)$$

where l_i and x_i denote the employment (number of persons) and output in sector i, respectively, b_{ij} is the i, j^{th} element of the closed Leontief inverse matrix (b), and n stands for the number of sectors.

Output elasticity measures the percentage change in aggregate employment in the economy resulting from a one per cent change in the Gross Output of a given sector. Therefore the output elasticity for sector *j* is defined as:

$$\varepsilon_o = \frac{\Delta\%\mathrm{L}}{\Delta\%\mathrm{O}} \quad (6)$$

where L is equal to total employment in the sector of the economy, *O* is final demand or output within the particular sector *j.*

The income elasticity measures the percentage change in aggregate employment in the economy resulting from a one per cent change in the income of a given sector. Therefore the income elasticity for sector *j* is defined as:

$$\varepsilon_Y = \frac{\Delta\%\mathrm{L}}{\Delta\%\mathrm{Y}} \quad (7)$$

where L is equal to total employment in the economy, *Y* is the income in sector *j*.