The Impact of a Lower NAIRU on the Australian Macroeconomy

Responses in the Treasury Macroeconomic (TRYM) Model

By

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1. INTRODUCTION

Unemployment is a costly outcome, particularly for individuals but also for the economy as a whole. "High unemployment means lower output, increased taxation, lower saving and the loss of skills and work experience. High unemployment can lead to greater inequality while at the same time reducing the capacity of society to support its less fortunate members."[1] Using the Treasury Macroeconomic (TRYM) model of the economy, this paper examines the potential macroeconomic benefits of permanently reducing the unemployment rate in Australia.

In examining unemployment macroeconomists have introduced the concept of a "natural" or non-accelerating inflation rate of unemployment (NAIRU). In practice, the NAIRU tends to represent a historical limit to which the unemployment rate can be sustainably reduced by aggregate demand policies without setting off wage-price spirals. Estimates in the TRYM model suggest that the NAIRU is around 7.0 per cent, although this estimate lacks precision, as in statistical terms there is a 95 per cent chance that the true NAIRU lies in the range 5.4 to 8.6 per cent. Estimates from other models have similar wide error bands. Moreover these estimates are average estimates for a period as a whole (in the above case 1974 to 1994) and there is even greater imprecision over where the NAIRU is at a particular point in time. There is also considerable uncertainty about how and why the NAIRU moves over time with various emphases being placed on insider and outsider arguments, the effect of productivity growth, competitiveness in product markets and labour market institutions.

What is clear however is that reducing the NAIRU (reducing the economy's propensity to generate wage price spirals) will confer significant benefits on the economy. The recognition of these and other benefits formed the basis of the Committee on Employment Opportunities Green Paper *Restoring Full Employment* that set out a strategy for both ameliorating the consequences of unemployment and reducing the NAIRU. The Green Paper report in turn formed the basis for the Government's response in the employment White Paper *Working Nation.*

> "In its White Paper the Government presents an ambitious vision of Australia in the year 2001. This Australia will be built on a stronger, more dynamic and productive economy which will allow us to sustain growth rates that we have previously managed to hold for only a few years at a time. It will help put a 5 per cent unemployment rate within our grasp around the turn of the century." Working Nation (1994) p2.

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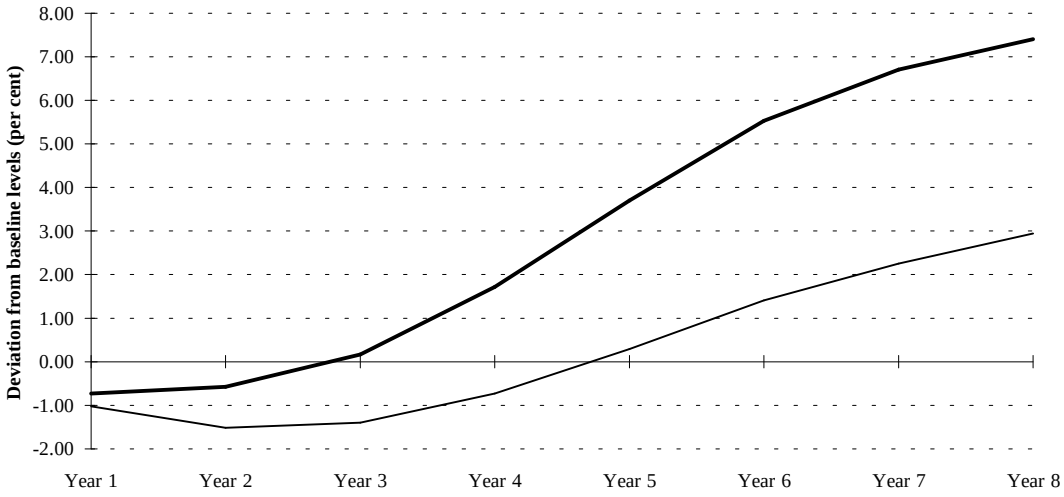
[1]Committee on Employment Opportunities (1993) "The Social and Economic Consequences of Unemployment" Background Paper 1H, *Restoring Full Employment: Background Papers,* AGPS P75

The appendix to the Green Paper contained modelling results that showed the potential benefits of reducing unemployment and the NAIRU. The key feature of these results was that individual workers (the insiders) were themselves better off with nominal wage restraint. This followed from the fact that lower nominal wage increases led to lower price increases so that the real wage was relatively unaffected in the medium to long term. Moreover, lower unemployment means higher employment, a higher revenue base and lower expenditure on unemployment benefits. The tax burden from the unemployed on existing workers is lifted, and moreover taxes are spread over a wider revenue base. These effects are quite substantial and lead to higher after-tax real wages (see Chart 1 below[2]). Moreover lower inflation means lower interest rates and a more quickly expanding economy. With higher employment and higher after tax real wages the living standards of the community in general are much higher. These results depend on the complex feedback effects that occur in the real economy. These feedback effects are often ignored in partial analyses of the labour market but are bought out in fully articulated models such as the Murphy model and TRYM.[3]

Chart 1: Living Standard For (a) Individual Workers and (b) The Community As A Whole



[2]This chart has been constructed from data in Figures A1 and A2 of the Green Paper, P203. Note the chart is in deviations from baseline levels.

[3]This follows from the fact that, in the model while workers have no influence on the wage they do not have any control over the price level. In the long run, in the model, real wages are almost exclusively determined by productivity growth.

A major motivation for writing this paper is to ascertain whether the Green Paper results (which were produced using the Access Economics Murphy model) also hold for TRYM.[4] Moreover doing this gives us the opportunity to trace through the linkages in a more detailed way than was possible in that earlier paper. It is important to understand the assumptions and linkages embedded in models prior to interpreting model simulation results. The model is only an approximation of the "real" economy and the results are necessarily heavily qualified and should not be interpreted in any mechanical way. Section 2 details the structure of the labour market in the TRYM model. Section 3 presents a full TRYM model simulation of the impact of a lower NAIRU, and how wage restraint flows through the economy. Section 4 draws some conclusions from this analysis.

[4]While there are many similarities between the models (they are both estimated on Australian times series data), there are significant differences in the specification of some equations, in the specification of the production function and the external sector and in assumed behaviour of financial markets.

2. MACROECONOMICS OF THE LABOUR MARKET

The TRYM model was designed as a simulation model, based on aggregate data that takes account of the major interactions and linkages in the macroeconomy. TRYM therefore has an aggregated, simplified interpretation of the Australian labour market. That said, these simple labour market equations do capture most of the broad trends and behavioural patterns of the Australian labour market.

In the TRYM model, the labour market is modelled by three structural equations; a wage setting equation (an expectations augmented Phillips curve), an employment equation (labour demand), and a labour force participation equation (labour supply). In the TRYM model households or workers make decisions on labour force participation and wage demands (independent from their consumption/savings choice), while firms determine employment levels (jointly with business output prices and business investment).

2.1 Wage Determination

2.11 Wages in TRYM

Chart 2: Unemployment, Wage and Price Inflation

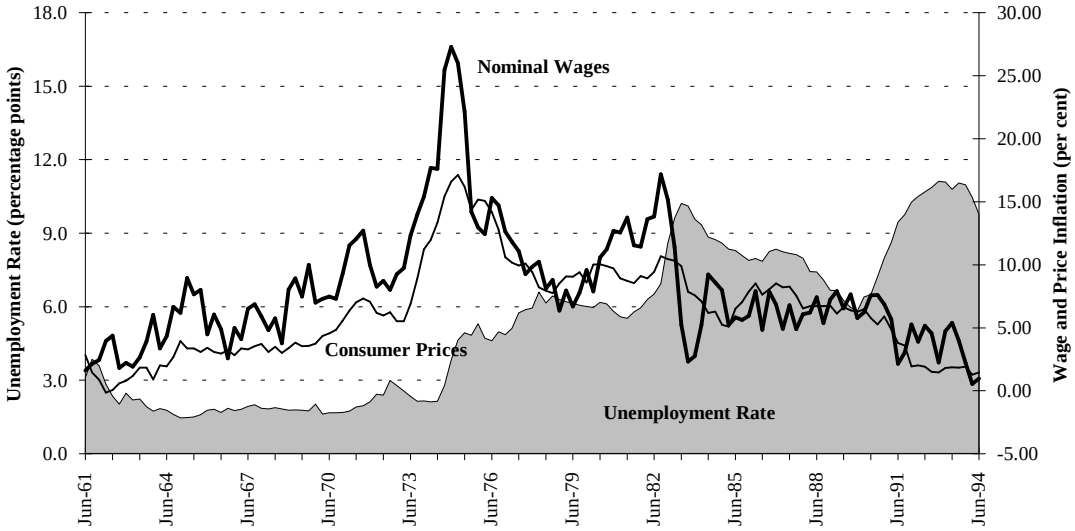


Chart 2 above depicts the evolution of the unemployment rate, and wage and price inflation in Australia over the past thirty years.

One of the dominant trends over the past two decades has been the tendency for the average unemployment rate to rise. The unemployment rate has tended to ratchet up over time, with relatively sudden increases that are only slowly unwound. The tendency for the unemployment to remain at high levels, for long periods, raises some questions about the nature of the NAIRU and in particular, the sensitivity of wages to unemployment.

Traditionally, unemployment has been decomposed into frictional, structural and cyclical components. The gradual rise in the unemployment rate, in association with the increase in long term unemployment (LTU), is suggestive that frictional and/or structural unemployment has increased over time. This rise in LTU could be associated with an increase in the NAIRU. That is, due to factors such as skills atrophy, diminishing job search skills, low morale and false signals that long unemployment duration may send to employers, the unemployment rate may not be exerting the same influence on wages that has occurred in the past. However these effects in themselves seem insufficient to explain the rise in the NAIRU. (For example indicators of the search effectiveness of the unemployed appear to have shifted by between one and two percentage points since the 1960s while estimates of the NAIRU have risen by around 4 percentage points.) Hence it seems likely that other factors are also at work.

The TRYM approach to modelling Australian wage behaviour, in common with other Australian models, starts with an expectations augmented Phillips curve. Under this approach, wage inflation (adjusted for productivity growth) is conditioned on expected consumer price inflation (proxied by a weighted average of current and past inflation) and the degree of excess demand in the labour market (measured by the deviation in the level of the unemployment rate from some NAIRU level[5]). At the heart of this model is the assumption that those people outside employment (the unemployed or "outsiders") will place downward on wages in periods of excess supply, and this will restore equilibrium in the labour market.

The TRYM wage equation augments this basic Phillips curve with modifications to allow for the wage behaviour of those inside employment or "insiders". Outsiders may be viewed as imperfect substitutes for insiders for a variety of reasons, including labour market rigidities or regulations, imperfect information, on-the-job training or significant transaction costs involved in hiring/firing decisions. In this world, insiders may find their jobs relatively more secure, and therefore be less sensitive to the level of the unemployment rate in determining wage claims. Simes and Horn (1988) used detrended overtime per worker[6] to capture this internal labour market pressure. In TRYM, this effect is modelled by a change in unemployment rate term (ΔRNU), where the increasing risk of unemployment influences insiders' wage claims.

The TRYM wage equation also includes a dummy variable (DCC) that attempts to capture the effect of various institutional arrangements such as wage indexation (between 1975 and 1981), the Wages Pause (introduced in 1982) and various Prices and Income Accord agreements (since 1983). This dummy attempts to measure the degree of centralisation in various wage regimes, set to 0.8 in highly centralised periods and 0.2 in relatively decentralised periods. The values broadly represent the proportion of movements in the average minimum wage rate attributable to the national wage case decisions. Since 1987, with the movement towards productivity based enterprise bargaining, DCC has been assumed to be slowly declining. The interest with this dummy is the effect that the degree of centralisation in wage fixation may have had on sources of wage pressure. The estimated

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[5]This unemployment/NAIRU level term enters the wage equation in a non-linear fashion as in the Phillips curve analysis.

[6]In different versions, Simes and Horn (1988) used both a detrended as well as a truncated asymmetric measure where only *increases* in overtime per worker feed into wage pressure.

coefficient suggests that more centralised wage regimes have tended to reduce the sensitivity of wage inflation to pressure by insiders.

Box 1: TRYM Wage Equation

$$\Delta\ln(WT)_t = \Delta\ln(NH)_t + CLAM/4 + (1-0.405)*\Delta\ln(PCON)_t + 0.405*\Delta\ln(PCON)_{t-1} + 0.108*[\Delta\ln(GBA)_t - \Delta\ln(GBA)_{t-1}] - (0.0123*DCC)*\Delta RNU_{t-1} - 0.0157*(DCC_t - DCC_{t-4}) + 0.0128*\{[NAIRU - RNU_t]/RNU_t\}$$

$$NAIRU = 7.03*(1-QS741) + 3.11*QS741$$

Where
- WT is the aggregate per person wage.
- NH is average hours worked per employee.
- PCON is the consumption price deflator.
- GBA is rain adjusted business output.
- RNU is the unemployment rate (percentage points).
- CLAM is the Harrod neutral rate of technical efficiency.
- DCC is a dummy variable for the degree of centralisation of wage setting.
- QS741 is a dummy variable equal to one before 1974(1), and zero thereafter.

Explaining the strong wages boom in 1974 has been a problem for many researchers and particularly macroeconomic modellers for many years. In the NIF10 model, wages where not fully endogenous, and the events of 1974 where captured by indexes for National Wage Case and Metal Trades award decisions. Simes and Horn (1988) in the NIF88 model also utilised dummy variables to account for the timing of Arbitration and Conciliation decisions (although allowed the magnitude of wage decisions to reflect market forces), yet still reported difficulties in explaining wages in 1974. Simes and Horn (1988) also note the that including 1974 data in their specification weakens the link between wages and the level of unemployment.

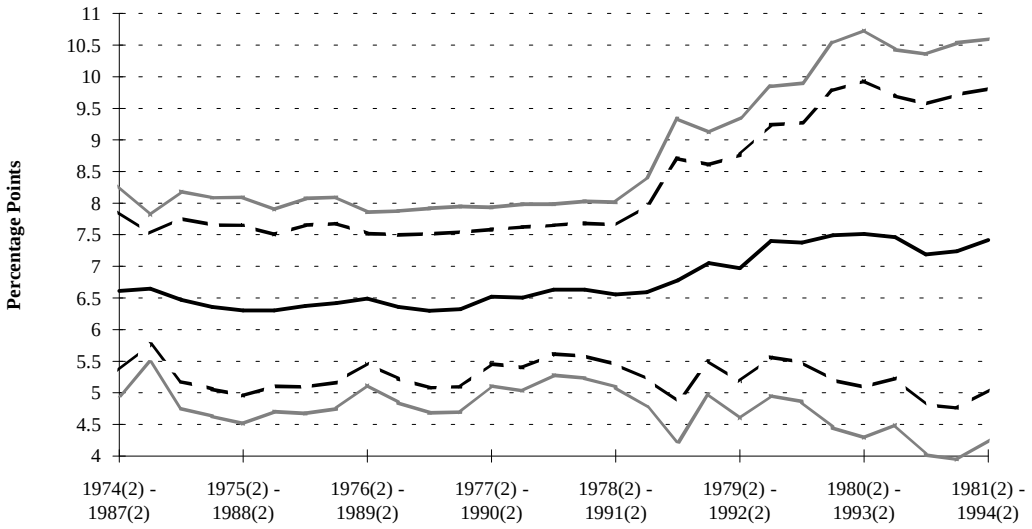
There is some evidence that the unemployment/vacancy (U/V) relationship or Beveridge curve shifted out in 1974. A recent study by Fahrer and Pease (1993) estimated a number of simple Beveridge curves. Using simple dummy variables they found a significant structural shift in September 1974 but not in September 1982. Their analysis of the underlying equilibrium relationships behind the Beveridge curve, suggest that while the Beveridge curve was relatively stable over the 1980s, offsetting movements occurred in the underlying foundations of the curve.

The approach adopted with the TRYM wage equation was to allow for a structural break in the otherwise constant NAIRU in the first quarter of 1974. The TRYM estimates suggest that the NAIRU increased in 1974 from around 3.0 per cent to 7.0 per cent. This increase in the NAIRU is larger than would be suggested by the shift in the Beveridge curve suggested by empirical studies. Estimates not incorporating this shift tend to lead to implausibly strong wage price dynamics and weaken the link between wages growth and the level of the unemployment rate.

The current TRYM estimate of 7.0 per cent is consistent findings of other studies by Simes and Horn (1988) and Murphy (1992) of 6.5 and 7.1 per cent respectively. That said, the TRYM estimate lacks, with a ninety five per cent chance that the true value of the NAIRU lying in the range 5.4 to 8.6 per cent.

A rolling regression of the wage equation[7] was performed to analyse the stability of the NAIRU estimate after 1974. Chart 3 below shows the estimates of the NAIRU, as a 13 year window is rolled through the data from 74(2) to 87(2), through to 81(2) to 94(2), along with the ninety five and ninety nine per cent confidence intervals. The estimates of the NAIRU have been increasing in recent periods, however it is close as to whether there has been a structural break since 1974.

Chart 3: Rolling NAIRU Estimates



2.12 Properties of the TRYM Wage Equation

In TRYM there is no long run hysteresis in the unemployment rate. That is, the constant NAIRU assumption implies that wages will adjust, influencing labour demand and supply, to ensure the unemployment rate returns to the NAIRU in the long run[8]. This is consistent with the unemployed or outsiders having some influence on wages in the long run. This may reflect the outsiders and insiders becoming closer substitutes, through, for example, labour turnover, retraining and skills acquisition by outsiders, greater flexibility by firms and a high unemployment rate increasing the risk of unemployment for insiders. Theoretically, a modelling the NAIRU as deterministic in the long run is a very appealing idea. Unfortunately to date this has not been very successful with aggregate time series data. While hysteresis is an attractive idea for the short to medium term, the idea that the unemployment rate is purely an accident of history is less appealing in the very long

[7]A version of the TRYM wage equation excluding the centralisation dummy was used.

[8]Both Murphy and NIF88 models also utilise a constant long run NAIRU. The earlier NIF10S model (the simulation version of the NIF10 forecasting model) related wages to changes in the unemployment rate, did not have a stable long run unemployment rate.

run. TRYM, like other Australian macroeconomic models, takes the position that the NAIRU in the long run is deterministic but has little explanation for its level.

This does not imply, however, that the 7.0 per cent estimate for the NAIRU is necessarily fixed or a desirable social outcome. The NAIRU estimate represents an historical average, below which, long run forces have tended to cause accelerating wage and price inflation. The Government's White Paper *Working Nation* (1994), outlines the Government's programs and policies aimed at reducing unemployment and the NAIRU. This paper focuses on examining the economy wide benefits of reducing the NAIRU.

While the TRYM model does not have unemployment hysteresis in the long run, there is a form of short run unemployment hysteresis by insiders (captured by a term for the change in the unemployment rate). The estimated wage equation suggests that even if the unemployment rate is above the estimated NAIRU, large falls in the unemployment rate can create higher wage pressures. There is an implicit short run NAIRU, which can be interpreted as a dynamic path of reductions in the unemployment rate, which do not cause an acceleration in wage inflation in the TRYM model[9]. This mechanism captures in the wage equation, the apparent persistence of high unemployment rates without market clearing wage adjustment, evident in historical data. Like the long run NAIRU, these short run rigidities are not necessarily fixed, and the Government's response in the White Paper is aimed at reducing these factors.

There is also reasonably strong wage-price dynamics in the TRYM model. The wage equation is based on backward looking expectations, with wage inflation depending on current and one quarter lagged inflation. The estimates suggest that an increase in the inflation rate of one percentage point, will result in a 0.6 percentage point increase in wage inflation immediately. This is important, in that, movements in the NAIRU (particularly in the presence of short run hysteresis), may generate significant variations in inflation.

Finally, the homogeneity constraint placed on prices in the TRYM wage equation, implies that it can be interpreted as a real wage equation. Therefore a reduction in the NAIRU can be interpreted as real wage restraint. A gap between the unemployment rate and the NAIRU causes real wage growth to slow (until the gap is removed). In the long run, however, real wages grow in line with productivity growth.

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[9]Conceptually this path could be constructed by inverting the wage equation and solving for the unemployment path that does not cause an acceleration in wage inflation. Unfortunately, the TRYM wage equation strictly speaking cannot be inverted as it contains a lagged change in unemployment term.

2.2 Labour Demand

Chart 4: Real Wages, Output and Employment

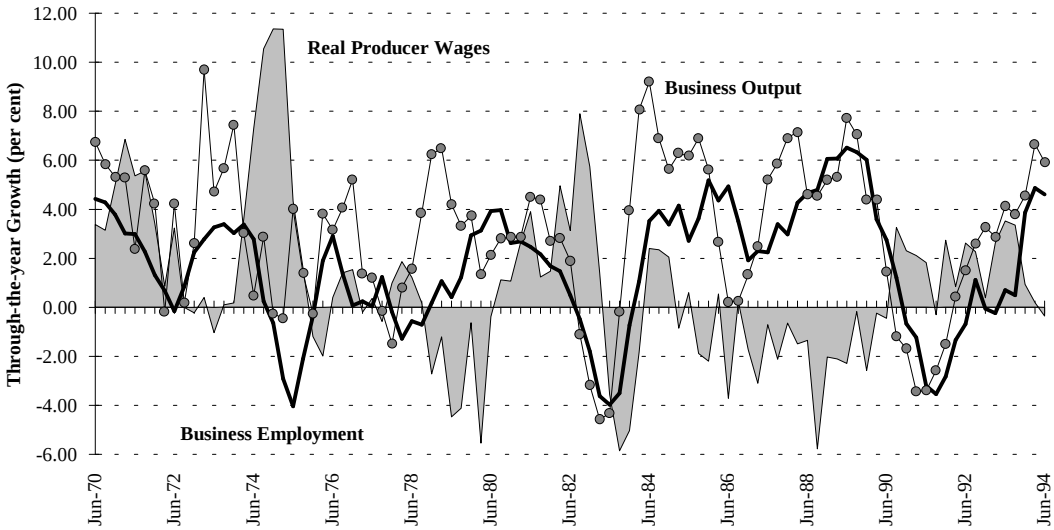


Chart 4 depicts real wage, private business sector output and employment growth. The chart suggests a strong correlation between employment growth and both output and real wage growth. In regard to real wages, strong growth in 1974 and 1982 appears to have played an important, leading role in the employment downturns in the 1974/75 and 1982/83 recessions. Similarly, the significant fall in real wages during the Wage Pause in 1982, as well as the sustained real wage restraint during the Accord period, appears to have supported strong employment growth.

In TRYM the employment decision is made by firms, jointly with their investment and pricing decisions. In the long run, firms are assumed to demand factor inputs (both labour and capital), supply and price their output in accordance with profit maximising behaviour subject to given technology. As production technology is not directly observable, factor demands and marginal cost pricing curves derived from the first order conditions of the profit maximising problem are jointly estimated to obtain production function parameters. TRYM assumes constant elasticity of substitution (CES) production technology with labour augmenting Harrod neutral technical progress.

In solving this maximisation problem, the long run demand for labour is obtained by taking the first order condition for labour and substituting into the production function. The demand for labour can then be expressed as a function of output and real wages (per efficiency unit). Further information on the theoretical underpinning's of labour demand in TRYM can be found in Taplin and Parameswaran (1993), while Brooker (1993) has a good comparison of the approaches in Murphy and TRYM.

In TRYM, labour input is measured in terms of total hours worked, reflecting variations in both heads and average hours worked per employee. This helps capture the effect of the trend decline in average hours worked per employee in the 1970s, partly as a result of the shift towards part-time work.

Box 2: Employment Equation

$$\Delta \ln(NB)_t = \Delta_8 \ln(NAP)_t/8 + 0.147*CSIG*[\Delta \ln(WBH*RTPRB/PGB)_t - CLAM/4] + 0.130*\Delta \ln(GBA_t/KB_{t-1}) + (1-0.706)*\Delta \ln(NH)_t - 0.245*\{\ln(NB*NH/GBA)_{t-1} - [CSIG*\ln(CLAB) - CSIG*[\ln(WBH*RTPRB/PGB)_{t-1} - CLAM*QTIME_{t-1}] - CLAM*QTIME_{t-1}]\}$$

Where NB is private business sector employment.

NAP is adult population (15 years and over).

WBH is the hourly private business sector wage.

RTPRB is one plus the rate of payroll and fringe benefit taxes incurred by the private business sector.

PGB is the price of private business sector output.

GBA is rain adjusted business output.

KB is the private business sector capital stock.

NH is average hours worked per employee.

QTIME is a time trend (which increases by 0.25 per quarter).

Estimated within the production sector are:

CLAM, the Harrod neutral rate of technical progress is 0.011

CSIG, the elasticity of substitution between labour and capital is 0.755

CLAB, the production function share parameter on labour is 0.35

The TRYM employment equation relates employment (in total hours) to real wages (per efficiency units) and underlying productivity growth in the long run, and includes short run dynamic terms to capture movements in real wages, average hours worked per employee and capacity utilisation. The short run dynamics capture features in the data such as labour hoarding and counter-cyclical productivity movements.

The estimated parameters for the TRYM employment equation suggest that real wages are an important determinant of employment. The estimated elasticity of substitution between capital and labour suggests, that a one per cent decrease in real wages leads to:

- an immediate increase of 0.15 per cent in employment initially, which builds to
- an 0.76 per cent increase in employment in the long run.

Similarly, the employment elasticity with respect to output suggests that a one per cent increase in output leads to:

- an immediate increase of 0.13 per cent in employment initially, building to
- a one per cent increase in employment in the long run by assumption (a consequence of the constant returns to scale in the assumed CES production function)

2.3 Labour Supply

Chart 5: Participation Rate and Employment Ratio

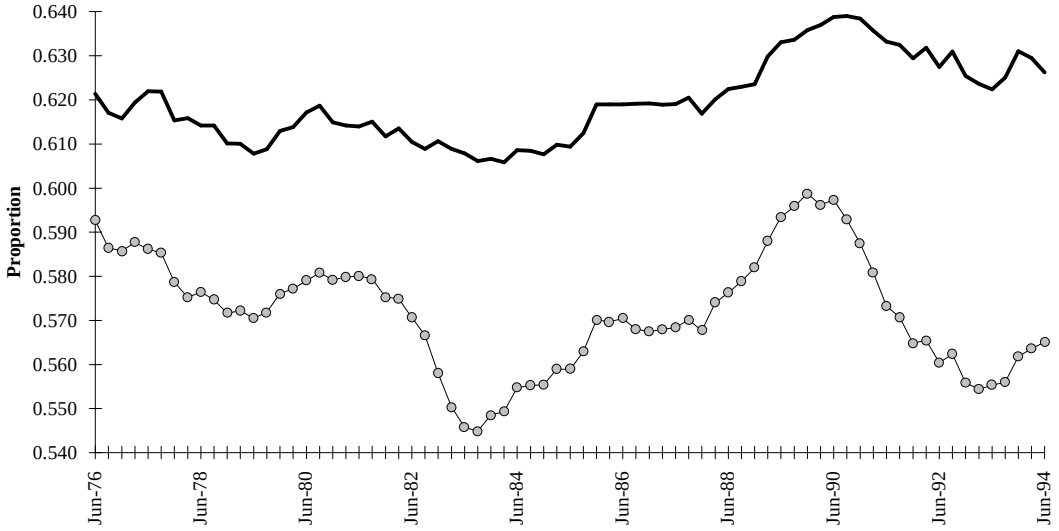
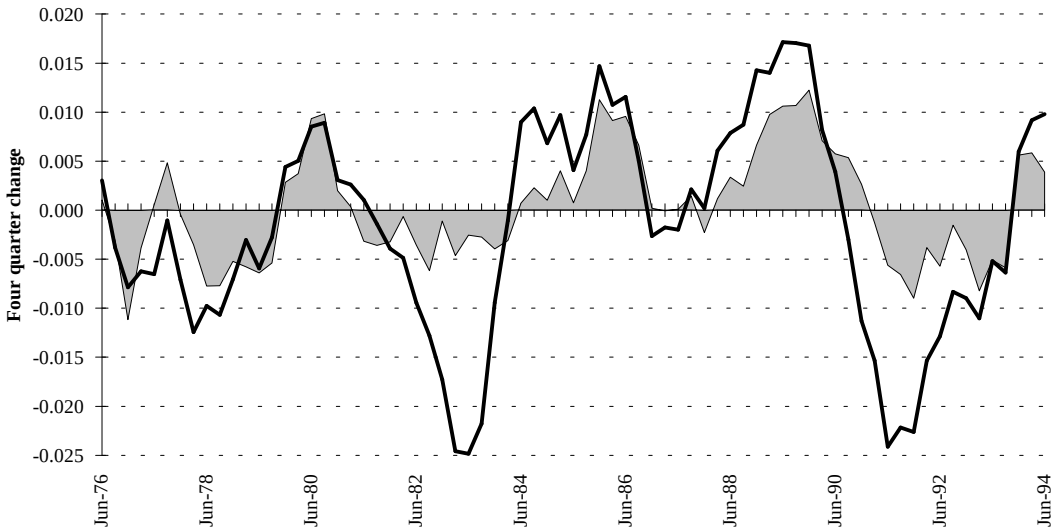


Chart 5 depicts the level of the participation rate and employment ratio since the late 1970s. There have been trends evident in the aggregate participation rate data over this period, particularly the slow decline between 1976 and 1983, and the strong increase in participation between 1983 and 1990. One economic factor that tends to have a strong correlation with the participation rate is the employment ratio. The employment ratio has a close correlation with the participation rate both in levels and in changes (Chart 6), suggesting an encouraged worker effect may be important in the data.

Chart 6: Participation Rate and Employment Ratio



Other factors influencing the aggregate participation rate may be trends at a disaggregated level (by gender or age), and demographic trends. The strong rise in labour force participation in the 1980s to some extent, reflected a strong increase in female participation (male participation declined), which may be associated with increasing part-time work and growth of the services sector of the economy. Similarly, a host of demographic factors, such as the movement of the baby boomer generation through the age distribution, may have influenced the participation rate of various age groups and generated secular movements in the aggregate participation rate. The TRYM aggregate labour force participation equation attempts to absorb these influences through two time trends for the 1970's and 1980's onwards.

In the TRYM model, labour force participation is a decision by households. Simple microeconomic theory suggests that the individual household's desired supply of labour (measured in hours) or work leisure choice, is a matter of households attempting to maximise utility trading off the utility generated by leisure against the utility obtained by earning labour income and consuming goods. Fundamental to this choice is the slope of the budget constraint, that is the real wage rate. The supply of labour (measured in hours) is then a function of the number of persons available, the number who wish to work and their desired average hours of work.

In applying this theory to the data there are a number of problems. In particular, there is difficulty in knowing what the desired average hours of work are, particularly in the presence of regulations on the working week. Traditionally, empirical studies have tended to model the decision on a heads basis.

The TRYM labour force participation equation uses a measure of the desired average hours that households would wish to supply. An examination of the average hours worked per employee data, suggests that it can be represented by a downward sloping logistical growth curve with cycles about this curve. It is then assumed that the observed cycle component reflects demand influences such as firms demanding greater overtime hours, while the logistical growth curve component reflects a movement in desired supply of average hours.

The TRYM labour force participation equation models participation (on an hours basis), as a function of real after tax hourly wages, the employment ratio (to capture an encouraged worker effect) and deterministic time trends.

Box 3: Labour Force Participation Equation

$$\Delta\ln(NLF*NHLR/NAP)_t$$

$$= + 0.552*[\Delta\ln(NT/NAP)_t - 0.158*[\Delta\ln(NT/NAP)_{t-2}$$
$$- 0.384*\{\ln(NLF*NHLR/NAP)_{t-1}$$
$$- [-0.369 + 0.528*\ln(NT*NHLR/NAP)_{t-1}$$
$$+ 0.0741*\ln[(1-RTN)*WT/(NH*PCON)]_{t-1} - CLAM*QTIME_{t-1}]$$
$$+ 0.00693*D80*(QTIME_{t-1} + 10.725) + 0.00326*QTIME_{t-1}]\}$$

where NLF is the civilian labour force.
NHLR is the desired supply of average hours worked per employee.
NAP is adult population (15 years and over).
NT is civilian employment.
WT is the aggregate per person wage.
RTN is the tax rate on labour income.
NH is average hours worked per employee.
PCON is the consumption price deflator.
QTIME is a time trend (which increases by 0.25 per quarter).
D80 is a dummy variable set to zero before 80(1) and one thereafter.

The TRYM results suggest that there is a small, positive and significant real wage effect on labour force participation for aggregate data (around 0.07). While microeconomic theory for the individual's labour supply is ambiguous about the appropriate sign for this elasticity, due to opposing income and substitution effects, the TRYM results seem plausible for aggregate data. While this elasticity is low, it is not perfectly inelastic as is the case with many other Australian macroeconomic models.

The encouraged worker effect (proxied by the employment ratio) appears reasonably strong and significant. The results suggest that a 1 per cent rise in employment will encourage the labour force to increase by around half a per cent.

The time trends are interesting, in that the participation rate grew more strongly in both the 1970s and 1980s than would have been suggested by the real wage elasticity of labour supply and the encouraged worker effect, suggesting that there may be important demographic factors determining participation. Moreover, this trend increase doubled in the 1980s, probably as a result of increased female participation.

2.4 Labour Market Interactions

Figure 1: TRYM Model Labour Market

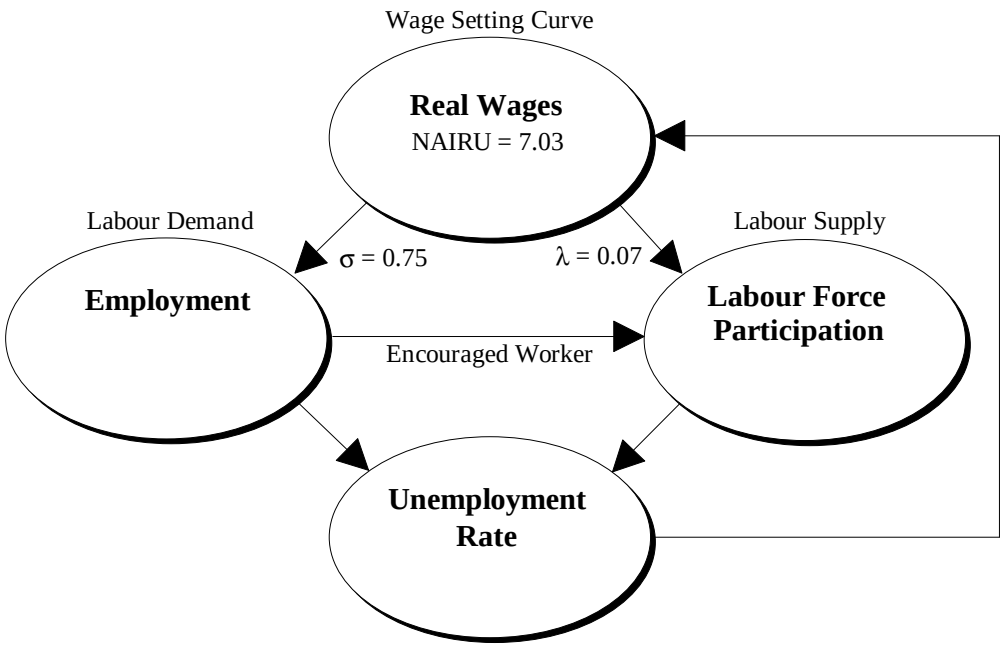


Figure 1 above schematically depicts the labour market in the TRYM model and the inter-linkages between the labour market equations. A lower NAIRU in the TRYM model has its direct impact in the labour market in the following manner:

- a lower NAIRU creates a gap between the current unemployment rate and the new NAIRU, and leads to greater nominal and real wage restraint or slower wages growth than would otherwise have occurred;

- real wage restraint has a direct impact on the firm's employment decision, the elasticity of substitution between capital and labour (0.15 on impact, rising to 0.75 in the long run) implies that firms will wish to substitute towards labour;

- real wage restraint has a direct impact on the household's labour force participation decision, the small elasticity of substitution between work and leisure (0 on impact, rising to 0.07 in the long run) implies a slight decrease in those willing to work;

  – much larger than this direct effect, however, is the encouraged worker effect where the improvement in employment prospects draws discouraged workers back into the labour force (this effect is around a half, both on impact and in the long run)); and

- as the increase in employment is stronger than the increase in the labour force, the unemployment rate falls towards the NAIRU.

3. A TRYM MODEL SIMULATION OF THE EFFECTS OF A LOWER NAIRU

This section examines the macroeconomic impact of an exogenous fall in the NAIRU by simulating the TRYM model. A comparison is made between two alternative paths for the economy (baseline and shock), where the only difference is the assumption about the NAIRU. We have used a TRYM model steady-state simulation as the baseline simulation for this paper.

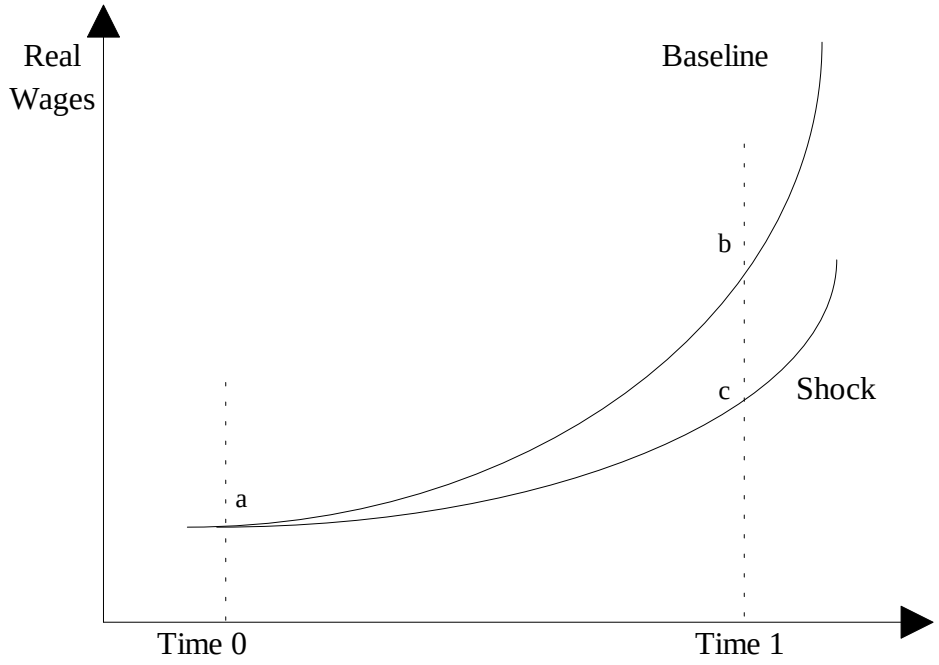
In TRYM a steady-state baseline has output growing in line with the supply potential of the economy, equal to the growth of factor inputs plus underlying productivity growth (the steady-state growth rate). Growth is balanced, all real variables growing at the same rate and relative prices do not change. Inflation is determined by the rate of growth of the money supply less the steady-state growth rate. Real wages grow in line with productivity growth. Australian real interest rates are equal to their world counterparts. Capital stocks have fully adjusted to equilibrium levels where the rate of return on capital equals the risk adjusted real interest rate, and labour is fully utilised with the unemployment rate equal to the NAIRU.

This steady-state world is somewhat different to the realities of a labour market today with the unemployment rate above the estimated NAIRU. Nonetheless it is a useful baseline for examining the pure effects of a NAIRU shock (one of the goals of this paper being to illustrate linkages in TRYM), as it will not be distorted by the lagged flow-on of past shocks in historical data.

In the shocked simulation, all exogenous factors are the same as the baseline simulation. The only exception being that the economy's NAIRU is assumed to fall by one percentage point immediately in the first quarter of the simulation and stay at the lower level.

In the description that follows, all references to movements in variables (up, down, increase, decrease, stronger or weaker), are relative to the baseline simulation. Movements are with respect to what would otherwise occur and not with respect to time. This distinction is illustrated in Figure 2 below with the example of a hypothetical "fall in real wages".

Figure 2: Deviation from Baseline



A "fall in real wages" refers to the deviation between the shock and baseline simulations. Consider Time 1; a "fall in real wages" refers to the gap (c-b), . Note this does not necessarily imply that real wages have fallen through time measured by the gap (c-a).

All results are presented as a deviations from the baseline level, usually as the per cent difference (unless otherwise indicated). The detailed results are presented in Table 1 at the end of Section 3, and in the following charts.

3.1 Short To Medium Term Impact

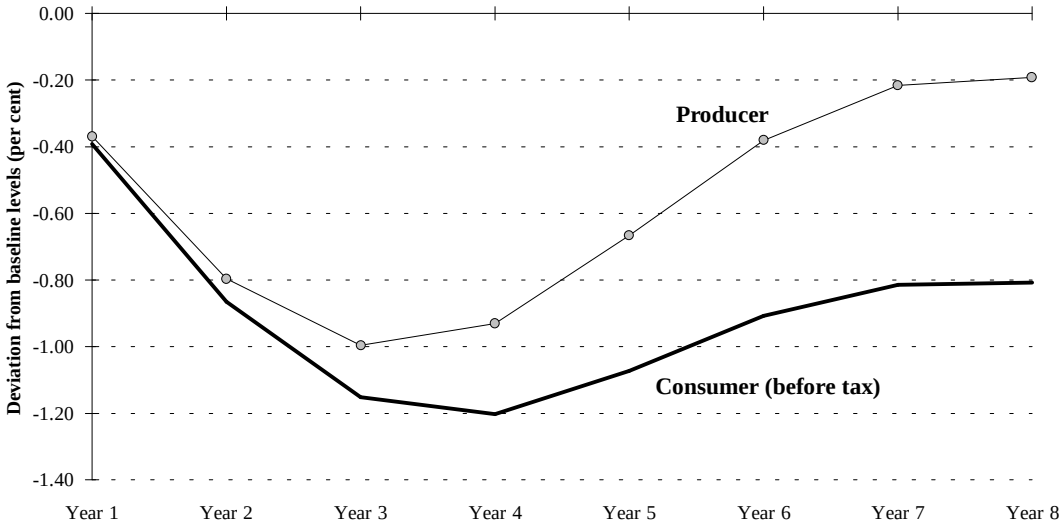
In the short to medium term in the TRYM model, aggregate demand determines the level of output in the economy. The initial impact of a fall in the NAIRU, however, is on the supply side of the economy. The gains from a reduction in the NAIRU are only slowly realised because wages and prices are sticky, and because firms and households only gradually change their behaviour in response to new information. Financial sector agents are assumed to take some account of future movements in the economy and therefore they respond relatively quickly.

3.11 Aggregate Supply Response

The fall in the NAIRU boosts the supply of effective labour. This could be thought of as increasing the relative labour market competitiveness of outsiders or an outward shift of the labour supply curve. This increases in excess supply in the labour market (the existing unemployment rate now higher than the new NAIRU), places downward pressure on both nominal and real consumer wages. Real wages (both consumer and producer) fall for the first 3 to 4 years of the simulation.

As the falling real wage starts to stimulate some falls in the unemployment rate, these improving labour market conditions start to encourage insiders to place upward pressure on wages. In the first three years the effect from outsiders dominates (lower wages pressure due to the gap between the unemployment rate and the NAIRU), however, by year 4 higher wages pressure from insiders starts to arrest and then reverse some of the fall in real wages.

Chart 7: Consumer and Producer Real Wages



Downward pressure on real wages slowly stimulates employment. The rise in the employment ratio encourages greater labour force participation[10], offsetting around half of the effect of the rise in employment on the unemployment rate. Employment is further stimulated by second round effects as demand and output start to respond to lower real wages and other factors (outlined below). Employment and labour force participation peak after 6 years. The unemployment rate steadily declines towards the new NAIRU and is around 1 percentage point lower after 4 to 5 years.

Chart 8: Employment and Labour Force

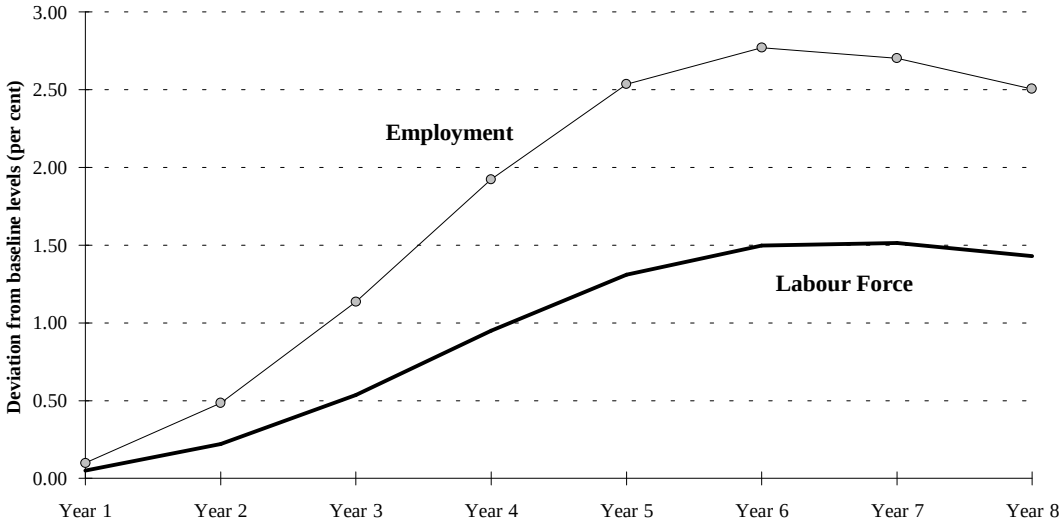
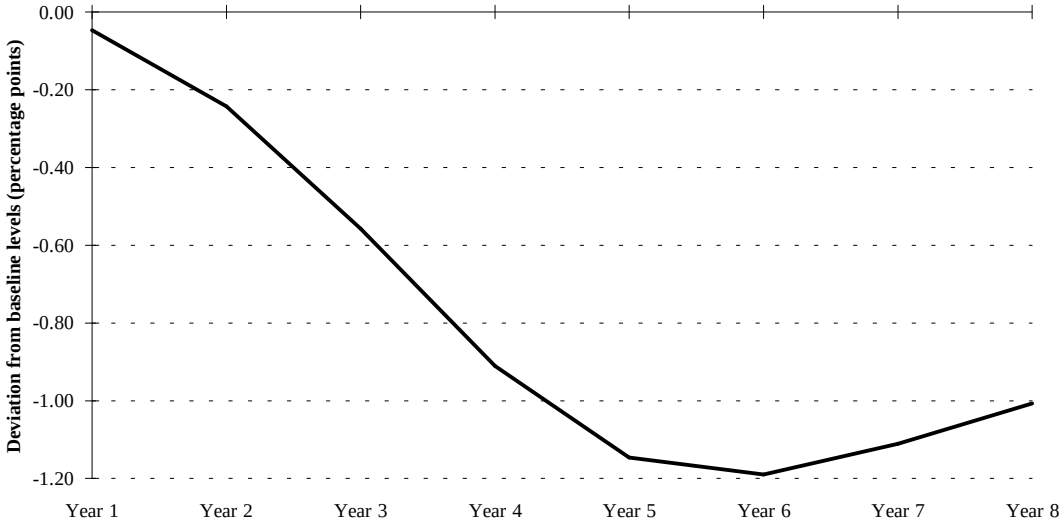


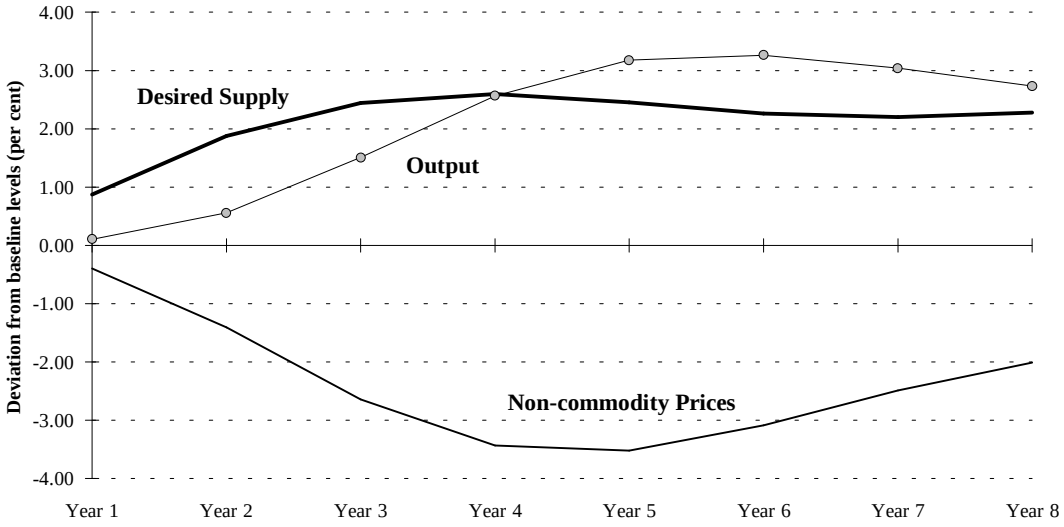
Chart 9: Unemployment Rate



[10]The fall in real wages detracts slightly from labour force participation directly through the small, positive elasticity of substitution between work and leisure in TRYM. In the short run this effect is comparatively small, and dominated by the much stronger encouraged worker effect.

The fall in producer real wages results in an increase in the level of output that firms would desire to supply if they were profit maximising. Current demand in the economy responds more slowly, and therefore actual output is less than this desired supply. Excess supply in the product market places downward pressure on domestic non-commodity prices. There is downward pressure on domestic non-commodity prices for the first four years of the simulation. This flows into lower consumer price inflation during the early years of the simulation.

Chart 10: Desired Supply, Output and Non-commodity Prices



3.12 Government Policy and Financial Market Responses

3.121 Monetary and Fiscal Policy Response

With the supply side effects of a lower NAIRU, leading to falling prices, real wages and unemployment there is the question how will the Government respond to these developments. There are a number of assumptions about how Governments react to shocks in the economy that are embedded in default policy reaction functions in the TRYM model. These do not necessarily represent how Governments *have*, *would* or *should* respond to developments in the economy, but are plausible, stable ways in which Governments *could* respond. The Government sector plays an influential role in the economy and stable policy rules are needed to close simulation models like TRYM.

The first question relates to how monetary policy and short term interest rates respond. The default monetary policy reaction function in the TRYM model, ties short term nominal interest rates to deviations in nominal GNE (a proxy for nominal transactions in the economy) from a fixed nominal target path desired by the monetary authorities for the economy. The growth rate of this nominal target path is consistent with the steady state growth of the economy plus the monetary authorities assumed target inflation rate.

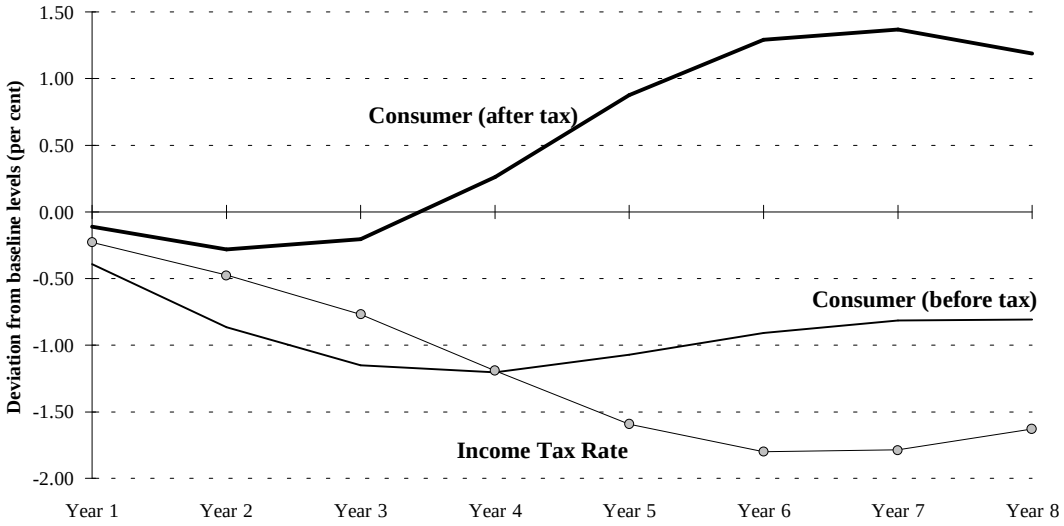
The nominal target path for nominal transactions in the economy defines the stance of monetary policy. For simplicity, we have assumed a non-accommodating stance for monetary policy (or in other words, a fixed money supply rule). Therefore in this simulation, lower prices reduce the transactions demand for money relative to the desired path, placing downward pressure on short term interest rates.

The next question relates to how fiscal policy (government expenditure, taxes and the net PSBR) respond. The default fiscal policy reaction function in the TRYM model, ties labour income tax rates to a public debt to nominal GDP target. Changes to the public sector borrowing requirement induced by shocks to the economy, are initially bond financed in the short run, however, in the long run are tax financed. Government market expenditure and employment does not change as a result of any other developments in the economy

We assume that the Government targets an unchanged long run stock of public debt to nominal GDP. Therefore in this simulation, the fall in unemployment benefit payments (as the unemployment rate declines), the fall in the public sector wage bill (as real wages decline), together with the boost to taxation revenues (as output increases), improves the net PSBR and gives scope for the Government to reduce income tax rates.

In this simulation, these tax cuts are significant, as while pre-tax consumer real wages are lower, post-tax consumer real wages start to increase after the third year of the simulation. The process working here could be thought of as a social wage / budget deficit trade-off, with the benefits from a lower NAIRU to the budgetary position being transferred to workers.

Chart 11: Fiscal Response and Consumer Real Wages



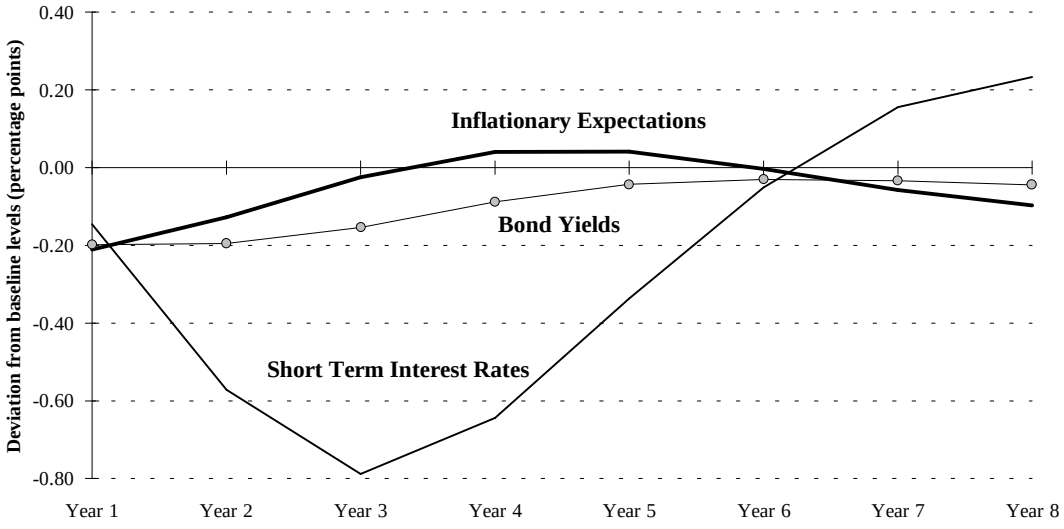
3.122 Financial Market Response

In the TRYM model financial market agents are assumed to exhibit forward looking behaviour, in that they are aware of any new information or shock and its implications for the long run exchange rate and price level. They then factor this information into their determination of both the current exchange rate and inflationary expectations[11].

Financial sector agents are assumed to understand that a lower NAIRU will increase the effective supply of labour and boost output in the long run. They also are aware of the non-accommodating stance of monetary policy, and that therefore prices will be lower and the nominal exchange rate will appreciate in the long run. Accordingly, they reduce their inflationary expectations immediately, and this flows into lower nominal bond yields. Lower Australian bond yields then open up an interest differential with the rest of the world, causing both the nominal and real exchange rate to depreciate (overwhelming the impact of an higher expected long run exchange rate) in the short run.

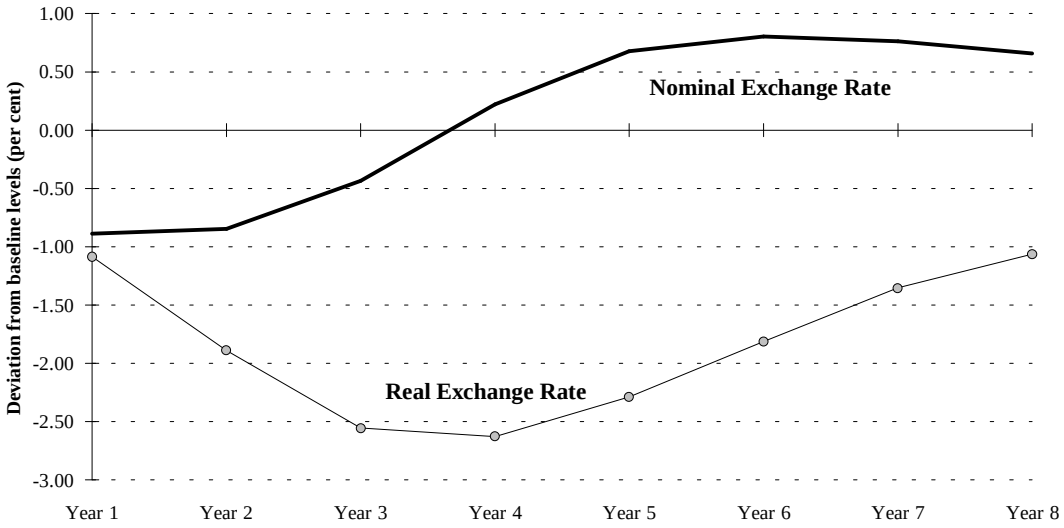
As the monetary authorities loosen short rates in response to falling nominal transactions, lower real short term interest rates flow into lower real bond yields.

Chart 12: Interest Rates and Inflationary Expectations



[11]This form of quasi-rational expectations is not as strong as the rational expectations (or more correctly model consistent expectations). While financial sector agents correctly anticipate the long run consequences of a shock or policy change, the dynamic path to this long run outcome has a backward looking orientation.

Chart 13: Exchange Rate

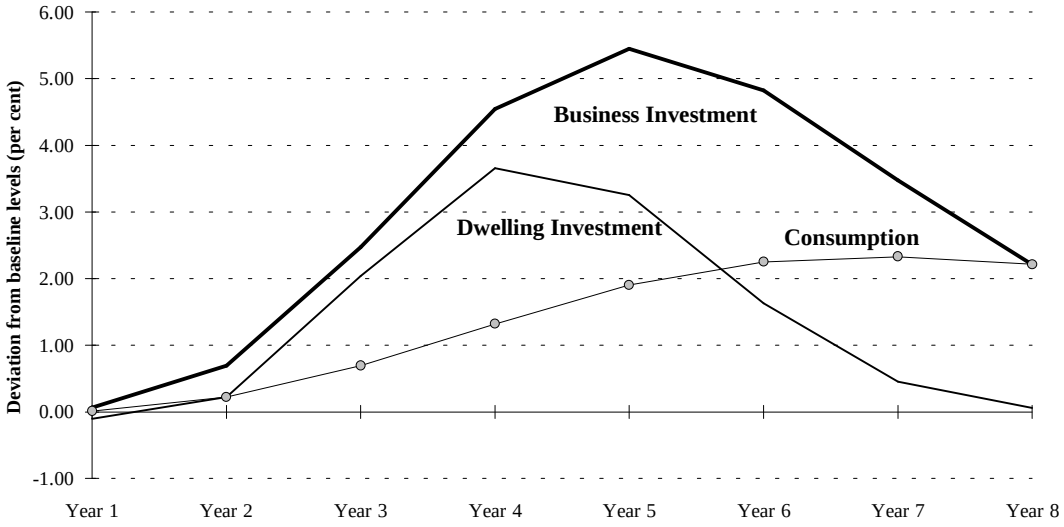


3.13 Aggregate Demand Response

The impact of developments on the supply side transmit to the demand side of the economy through movements in real wages, interest rates and the exchange rate.

Private consumption reacts slowly to changes in the economic environment. Initially the impact on consumption of a lower real after-tax consumer wage in the first three years, is offset by a higher value of wealth (as interest rates fall and asset prices rise) and consumption is little changed. However, as the income tax rates start to decline (due to the fiscal reaction function), real disposable incomes recover and consumption is higher.

Chart 14: Consumption, Dwelling and Business Fixed Investment



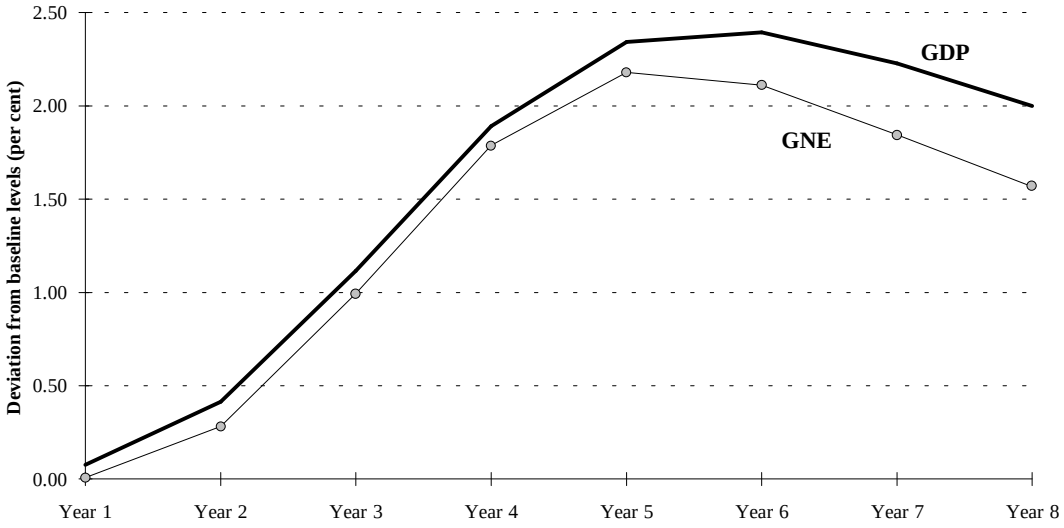
Lower real interest rates (both long and short) stimulate dwelling investment which is the most interest sensitive expenditure component in TRYM.

Business investment responds the most strongly of all the expenditure components. This reflects the fall in producer real wages increasing firm profitability, and therefore the rate of return on their capital, as well as the lower cost of funds due to lower real interest rates. Both these mechanisms encourage firms to adjust their capital stock toward new higher desired levels.

GNE is little changed in the first year of the simulation, however, grows strongly in the following years as lower producer real wages, lower real interest rates and higher consumer after-tax real wages have a lagged impact on GNE components.

Net exports are higher throughout the simulation. This reflects both the depreciation in the real exchange rate which boosts the external competitiveness of Australia's non-commodity exports and the import competing sector, while the fall in domestic non-commodity prices boosts the internal competitiveness of commodity exports.

Chart 15: Gross National Expenditure and Gross Domestic Product



Both GNE and GDP are higher throughout the simulation period. GNE and GDP respond relatively slowly in the first two years, however, by the third year are growing strongly. The increase in GDP and aggregate demand feeds back into to the labour market, increasing employment and reducing the unemployment rate towards the new lower NAIRU.

Material living standards improve through increased after-tax incomes and higher consumption. For the individual worker, the rise in after tax real wages implies both the newly employed former outsiders and the original insiders are better off. The rise in after-tax real wages and employment, implies higher real disposable incomes and improved material living standards for the community as a whole.

Chart 16: Living Standards For (a) Individual Workers and (b) The Community As A Whole

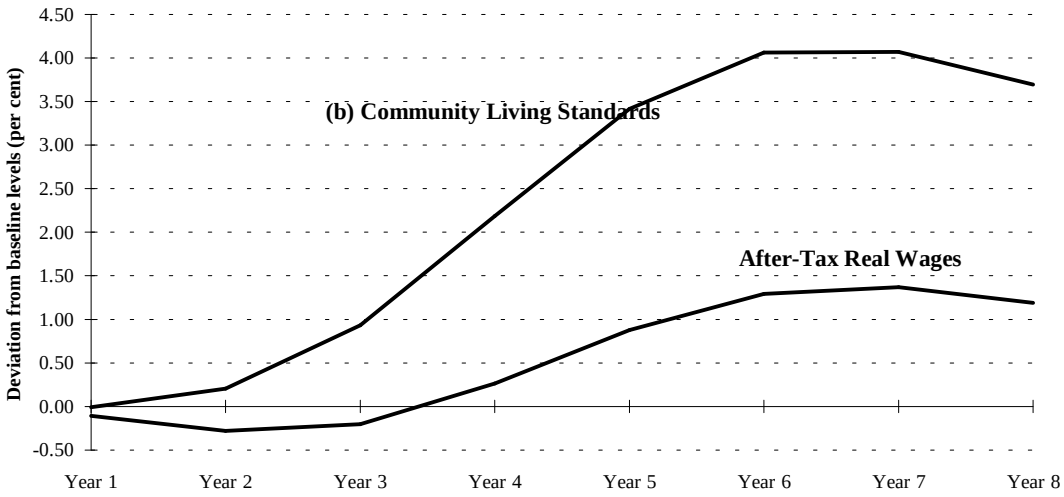


Chart 15 shows that the increase in material living standards in the TRYM results are similar to those found in the Green Paper analysis using the Murphy model (bearing in mind the Green Paper analysis was based on a 2 percentage point NAIRU reduction).

3.2 Stabilising Forces In The Medium Term

Some of the stimulus to GNE and GDP from lower real wages, lower real interest rates and a lower real exchange rate is unwound after four to five years as the economy starts to adjust towards a new equilibrium.

In the financial markets, real short term interest rates start to rise (flowing into real long term rates), as increasing real GNE leads to a recovery in nominal transactions, unwinding this source of stimulus to the economy. There is no new source of stimulus from the real exchange rate, as it stabilises around its new lower level.

In the labour market, the downward pressure on real wages is abated as the unemployment rate approaches the new lower NAIRU. Indeed, as the reductions in the unemployment rate accelerate (after year 2), some upward pressure on wages is generated as insiders see improvement in the labour market.

In the product market, excess productive capacity is eliminated by year 4, moving into excess demand after this time. This occurs as aggregate demand responds to real wages, real interest rates and the real exchange rate, overtaking desired supply. This arrests the fall in the level of non-commodity prices, stabilising prices at a new lower level.

3.3 Long Term Impact

In the long run in TRYM, supply side factors determine the level of output in the economy.

Real wages adjust fully to return the unemployment rate back to the NAIRU (in this case at a new lower level). Accordingly, the unemployment rate falls by one percentage point. This is a consequence of the specification of the wage equation in the TRYM model, where real wages will adjust to "clear" the labour market in the long run. In order to reduce the unemployment rate permanently by one percentage point, employment needs to increase by around 2.5 per cent, which is sufficient to account for the encouraged worker effect on labour force participation (around 1.4 per cent). In the long run, a 0.3 per cent fall in producer real wages is required to achieve this employment outcome. This implies a long run real wage elasticity for business sector employment of around 20, which is similar to that found by Brooker (1993) for the Murphy model.

With a higher level of employment, domestic supply and therefore GDP increases by around 2.5 per cent. The capital stock increases broadly in line with output (as does the level of investment), as the relative cost of capital is little changed as Australian real interest rates return world levels (through the interest parity condition).

The price level in the economy is determined by the stance of monetary policy. The non-accommodating assumption in this analysis (that is, a fixed nominal transactions target), implies that the price level is squeezed with higher output (consumer prices falling by around 2.3 per cent). The inflation rate (as opposed to the price level) returns to the monetary authorities target rate.

A lower domestic price level (with world prices unchanged) causes the nominal exchange rate to appreciate (by around 1.1 per cent). A downward sloping demand curve for Australian exports, however (due principally to non-commodity exports such as manufactures and services), implies that as the domestic supply of exports increases, the real exchange rate depreciates (by around 1.1 per cent)[12].

On the demand side of the economy, aggregate demand and its components: private consumption, private investment, exports and imports, increase to match the expansion of aggregate supply. There is, however, some change in the composition of demand, due to unchanged government final demand (by assumption) and a shift in relative prices of expenditure as a result of the real exchange rate depreciation (shifting demand towards less import intensive expenditures). The real exchange rate depreciation boosts net exports. The current account deficit as a percentage of nominal GDP is little changed with a decrease in the NAIRU, as the expansion of net exports is broadly offset by deterioration in the terms of trade.

The long run results of a lower NAIRU are therefore higher after tax real wages, higher employment, labour force participation, capital stocks and GDP. Similarly, consumption, investment, exports and imports are higher.

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[12]In the long run, this effect drives the reduction in real wages by shifting relative prices. The real depreciation increases the cost of imported capital goods, and this increases the user cost of capital. A higher user cost of capital implies a less capital intensive, and more labour intensive economy. A real wage reduction is then required to increase the labour output ratio.

Table 1: Impact of a One Percentage Reduction in the Non-accelerating Inflation Rate of Unemployment (NAIRU)

	Deviations from a steady-state baseline (per cent)							
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 8**	**Long Run**
Demand and Output								
Consumption	0.0	0.2	0.7	1.3	1.9	2.3	2.2	2.8
Business Investment	0.1	0.7	2.5	4.5	5.4	4.8	2.2	2.6
Dwelling Investment	-0.1	0.2	2.0	3.7	3.3	1.6	0.1	3.1
Government Final Demand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stock-building (a)								
Gross National Expenditure	0.0	0.3	1.0	1.8	2.2	2.1	1.6	2.2
Net Exports (a)	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.4
Gross Domestic Product	0.1	0.4	1.1	1.9	2.3	2.4	2.0	2.5
Balance of Payments								
Commodity Exports	0.1	0.3	0.8	1.5	2.2	2.9	3.5	3.5
Non-commodity Exports	0.3	1.0	1.8	2.5	3.1	3.3	3.1	2.4
Total Exports	0.2	0.6	1.2	1.9	2.6	3.0	3.3	3.1
Total Imports	-0.2	-0.1	0.6	1.3	1.7	1.7	1.3	1.7
Terms of Trade	-0.2	-0.6	-1.0	-1.2	-1.2	-1.1	-0.8	-0.6
Current Account Deficit (b)	0.0	-0.1	-0.1	0.0	0.1	0.1	-0.1	-0.1
Wages and Prices								
Nominal Wages	-0.6	-1.8	-3.1	-3.8	-3.6	-3.0	-1.9	-2.5
Business Output Prices	-0.2	-1.0	-2.1	-2.8	-3.0	-2.6	-1.7	-2.2
Consumer Prices	-0.2	-1.0	-2.0	-2.6	-2.6	-2.1	-1.1	-2.3
Real Producer Wages	-0.4	-0.8	-1.0	-0.9	-0.7	-0.4	-0.2	-0.3
Real Consumer Wages (before tax)	-0.4	-0.9	-1.2	-1.2	-1.1	-0.9	-0.8	-0.2
Real Consumer Wages (after tax)	-0.1	-0.3	-0.2	0.3	0.9	1.3	1.2	1.5
Labour Market								
Employment	0.1	0.5	1.1	1.9	2.5	2.8	2.5	2.5
Labour Force	0.0	0.2	0.5	0.9	1.3	1.5	1.4	1.4
Unemployment Rate (c)	0.0	-0.2	-0.6	-0.9	-1.1	-1.2	-1.0	-1.0
Financial								
Short Term Interest Rates (c)	-0.1	-0.6	-0.8	-0.6	-0.3	-0.1	0.2	0.0
Long Bond Yields (c)	-0.2	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0
Inflationary Expectations (c)	-0.2	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0
Exchange Rate	-0.9	-0.8	-0.4	0.2	0.7	0.8	0.7	1.1

(a) Percentage point contribution to the deviation in real GDP.
(b) Percentage points of nominal GDP.
(c) Percentage points.

4. CONCLUSION

The TRYM model simulation results suggest that reforms that reduce the NAIRU and make a more efficient use of Australia's labour force has significant benefits for the macroeconomy as a whole. A lower NAIRU leads to higher employment, higher labour force participation and a lower unemployment rate. An increase in employment results in higher production and GDP.

Compared with partial analyses of employment equations, the full model simulation in this paper suggests that a relatively small degree of real wage restraint (on a pre-tax basis by workers), can have quite a large impact on employment and GDP in the longer term. Typically, partial analyses ignore the important direct and indirect effects of real wage restraint on output. For example, the TRYM results show real wage restraint increasing the rate of return on capital, which in turn increases investment and therefore GDP. The expansion in output then further boosts employment. The increasing implied elasticity of employment with respect to the real wage (as output responds) in the TRYM results is also found in other full model analyses such as Brooker (1993) using the Murphy model.

With additional GDP and lower unemployment, the TRYM results show that all sections of the community could potentially be made better off. In the TRYM simulation, an improved fiscal position due a lower NAIRU (due to higher revenues and lower unemployment payments), makes room for lower income taxes[13]. Material living standards are higher for individual workers due to the increase in after-tax real wages (both for newly employed former outsiders, and insiders). Community material living standards are higher, reflecting increased after-tax labour incomes and consumption.

Overall the TRYM model analysis indicates that finding ways to reduce the NAIRU could lead to significant benefits for the economy and the community. As the White Paper put it in 1945:

> "To prevent the waste of resources which results from unemployment is the first and greatest step to higher living standards."

[13]Of course, greater public employment, government transfer payments or government market demand, are possible alternatives to the default income tax adjustment in TRYM.

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