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**AN EMPLOYMENT EQUATION FOR
AUSTRALIA: 1966-2001**

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An Employment Equation for Australia: 1966-2001

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ABSTRACT

We model the relationship between hours of work and employment and argue that unless actual hours are varying with a change in 'standard hours', actual hours should not appear in the long-run component of an equation for employment. If however standard hours are changing then it is desirable that this variable be incorporated into the employment equation. Our theoretical model yields an expression for the elasticity of employment with respect to standard hours which shows that the elasticity is related to the size of the premium for overtime. Using quarterly data for the period 1966:3 – 2001:3 we estimate a new employment equation for Australia incorporating standard hours of work. We find empirical support for our approach and we provide new estimates of the elasticity of employment with respect to the real wage and GDP. We also find a marked asymmetry in the response of employment to variations in real GDP and real wages in recession periods as against non-recession periods.

JEL Codes J200 J230

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An Employment Equation for Australia: 1966-2001

I Introduction

This paper argues that it is important in explaining employment to allow for changes in 'standard hours of work'. Recent research into the employment equation in Australia has ignored standard hours entirely (Russell & Tease (1991), Phipps & Sheen (1995) and Lewis & MacDonald, 2002)). Some studies have incorporated hours of work into their employment equation but have imposed a long-run elasticity of minus one on the coefficient relating employment to hours (Commonwealth Treasury (1996), Stacy & Downes (1995), Downes and Bernie (1999)). We argue that the relationship is likely to be such that the long run coefficient (elasticity) of the number employed with respect to (standard) hours will be neither zero or minus one, but instead will likely be positive and less than one. We model the relationship between hours and employment and then undertake empirical work to estimate a new employment equation for Australia incorporating standard hours of work.

We begin with a brief summary of the findings of recent research. Section III explains how we approach the relationship between hours and number of persons employed and sets out the testable hypotheses which result from our approach. In section IV we estimate an employment equation with the number of non-farm wage and salary earners as the dependent variable and compare our results with those obtained by other researchers. We argue that other researchers whose sample period includes the 70s and early 80s (the period when standard hours were falling markedly) have likely overstated the size of the elasticity of employment with respect to real wages when output is held constant.

II Employment Equations for Australia

It is possible to model labour services or aggregate hours worked (as in Debelle & Vickery, 1998), however, given the importance of modeling unemployment it is natural to seek a labour demand or employment equation which can be directly expressed in terms of number of persons employed rather than number of aggregate hours worked. Also, as Dungey & Pitchford (1998, p 220 – appealing to Hamermesh,

1993) have noted: “naïve labour demand equations of this type have some merit as a benchmark for more sophisticated analysis”.

The most recent published paper with an employment equation¹ for Australia is that by Lewis & MacDonald published in this journal in 2002. Prior to that there were papers by Russell & Tease (1991), Phipps & Sheen (1995) and (by far the most interesting given the thrust of this paper) Dungey & Pitchford (1998). All of these models have serious short-comings in our view. We briefly consider each in turn.

In an Appendix to their paper on the relationship between employment output and unit labour costs, Russell & Tease (1991) examine the relationship between total non-farm full-time employment and both real non-farm GDP and the real cost of labour² over the period 1969:3 – 1987:4. The long-run elasticity³ of employment with respect to output⁴ is 0.75 while the long-run elasticity of employment with respect to the real wage is -0.37 (Russell & Tease, 1991, p 44).⁵

Phipps & Sheen (1995) examined total non-farm employment in relation to real non-farm GDP and real average weekly earnings⁶ over the period 1979:1 – 1993:3. The elasticity of employment with respect to output is “estimated at just under 0.75” while the elasticity of employment with respect to the real wage “is about -0.7” (Phipps &

¹ There have been a number of papers modelling aggregate hours worked (eg Debelle & Vickery (1998) and many papers associated with TRYM, eg Commonwealth Treasury (1996), Downes & Bernie (1999), Stacey & Downes (1995). While these papers are not unrelated to this study we do have as our central focus a single equation modelling the number of people employed, and which does not treat this as simply given by the number of aggregate hours worked divided by average hours worked.

² Measured as non-farm wages, salaries and supplements plus payroll and fringe benefit tax deflated by the IPD for non-farm GDP.

³ The elasticities we report here for the Russell & Tease paper differ from those reported by Dungey & Pitchford (1998, p 222) who list the elasticities given in Russell & Tease (1991) for the case where unit labour costs are used as an explanatory variable. We report elasticities given in Russell & Tease for the case where the real cost per employee (not per unit of output) is used as an explanatory variable.

⁴ Researchers often find elasticities of employment with respect to output which depart quite markedly from unity and yet do not remark upon this or worry that it might suggest mis-specification.

⁵ The coefficient on the lagged dependent variable is 0.81, which is consistent with an error correction parameter of -0.19, suggesting that adjustment is ‘slow’. They report no evidence of structural change.

⁶ Nominal earnings are compiled on a national accounts basis. (Average earnings on a national accounts basis are composed of non-farm wages, salaries and supplements - including irregular bonuses, worker’s compensation, superannuation and redundancy payments - per wage and salary earner. See Reserve Bank of Australia (1996).) Real earnings are obtained by using the IPD for non-farm GDP as the deflator.

Sheen, 1995, p 95). They estimate their model with all variables in first-differences and so do not provide a direct estimate of technological change.⁷

Lewis & MacDonald (2002) estimate an employment equation for the period 1959:3 – 1998:3. They postulate that the number of employed non-farm wage and salary earners can be explained by real GDP (including farm production), real wages and a time trend.⁸ The Johansen method shows that the assumption of weak exogeneity is accepted for real wages and GDP. Their estimated employment equation yields long run coefficients (reported on page 24 of their paper, RH column) which indicate that the elasticity of employment with respect to real GDP is 1.05 and the elasticity of employment with respect to the real wage is -0.46. The estimated coefficient on the time trend in their equation implies (as corrected by Dowrick and Wells, 2003) that technological change is proceeding at a rate of 2.2% per annum). Lewis & MacDonald conduct various tests for stability and find that “the long run relationship obtained [in the employment equation] is indeed stable” and that “for the employment equation there is a robust and stable set of parameter estimates” (Lewis & MacDonald, 2002, p 27).

As noted above, Lewis & MacDonald (2002) have as their sample period 1959:3 – 1998:3, which encompasses a period in the late 70’s and early 80’s in which there were quite marked reductions in standard hours of work (defined as ‘the number of ordinary hours specified by an award or an agreement beyond which overtime or penalty rates become payable’) across much of the economy. An interesting question then is whether Lewis & MacDonald were right to omit reference to hours and especially standard hours in their employment equation and also, given the purpose of their study, whether omitting standard hours has resulted in their obtaining a biased estimate of the elasticity of employment with respect to the real wage.⁹ We return to these important questions in the empirical section of this paper.

⁷ Except for saying they choose their starting point to avoid complications related to the oil price shocks of 73/4 and 78/9 (1995, p 92 and p 102, n12), they do not discuss structural change or the stability of their equation.

⁸ Real wages in their study are measured as the weekly wage of non-farm employees deflated by the GDP deflator.

⁹ Not including average hours worked or standard hours would not be a major problem if they were constant. It would also not be an issue if our primary interest was in (say) the elasticity of employment with respect to the real wage (the elasticity of substitution), and also if hours were totally uncorrelated with the real wage. However, given that the three papers summarised above include in their sample

None of the studies reported above included any measure of actual hours worked or standard hours worked in their equations for employment. Effectively they are imposing a coefficient of zero on average hours in the employment equation. At the other extreme is the employment equation which is implicit in TRYM (Commonwealth Treasury (1996), Downes & Bernie (1999), Stacey & Downes (1995)) where a long-run coefficient of minus one on actual hours worked is imposed on the employment equation.¹⁰ The only recent study of the employment equation for Australia which not only explicitly includes (average) hours but also allows the elasticity of employment with respect to hours to be estimated is by Dungey and Pitchford (1998, p 219-22 and p 233). They estimate an equation with total non-farm employment as the dependent variable with total average weekly hours, real aggregate GDP¹¹ (including farm production), real wages¹² and a time trend as explanatory variables. Their sample period is 1984:4 – 1997:1. The long run coefficients suggest that the elasticity of (total non-farm) employment with respect to GDP is 1.30 and the elasticity of employment with respect to the real wage is -0.40.¹³ The real wage

period the 70's and early 80's when standard (and actual) hours of work were falling markedly, the models are quite likely omitting a relevant variable and, to the extent that this omitted variable is correlated with the real wage, we would expect their estimate of the elasticity of substitution to be biased. It is possible to speculate a little on the direction of the bias. Standard hours fell quite markedly during the 70s and much of the fall was occurring at the same time as real wages were rising very fast. It is likely then, that if falling standard hours are included along with these other variables, that the elasticity of employment with respect to the real wage will be lower (nearer to zero) than if the employment equation were estimated without standard hours being included.

¹⁰ Strictly speaking the TRYM labour demand equation is best viewed as an equation for labour services (the product of the number of persons employed and average hours worked). Debelle and Vickery (1998) also work with a labour services equation (ie the dependent variable is aggregate hours worked) but when they come to model unemployment they assume that average hours are constant (Debelle and Vickery, 1998, p 254).

¹¹ While it is odd that the measure of employment refers to the non-farm sector while the measure of aggregate production includes the farm sector, it is the case that, over their sample period (1984:4 – 1997:1), the level of real (total) GDP and the level of real non-farm GDP are very highly correlated ($r = 0.999$).

¹² Measured as average weekly earnings calculated on a national accounts basis deflated by the IPD for private consumption expenditure. The use of a deflator involving consumption expenditure prices is appropriate for a supply of labour equation but not for a demand for labour equation. However over the data period they use 1984:4 – 1997:1 the price index for private consumption expenditure and the price index for non-farm GDP are very highly correlated ($r = 0.996$).

¹³ The error-correction parameter is estimated to be -0.306 suggesting that the bulk of any adjustment takes place within one year of the shock. Short run dynamics included in the estimated equation suggest that an increase in the real wage results in a decrease in employment in the short run (as well as the long-run) and an increase in GDP results in an increase in employment in the short run (as well as the long-run). They report that estimation “over a longer time period suggests similar wage elasticities, and the standard Chow tests do not indicate breaks in the relationship. However, recursive estimations indicate that the regressions had difficulty fitting the data in the early 1980's” (Dungey & Pitchford, 1998, p 221).

elasticity is lower than that given by Lewis & MacDonald (-0.46) but this is to be expected, even allowing for differences in their sample periods. This is because the dependent variable in the Lewis & MacDonald equation is the number of (non-farm) Wage and Salary earners not (non-farm) Total Employment. Since some of the adjustment of labour services to a change in the real cost of labour would involve substitution of unpaid family workers for wage and salary employees and given also that a fall in the demand for wage and salary earners might lead not only to an increase in unemployment but also to an increase in the number of self-employed, we would expect the elasticity of total employment¹⁴ with respect to labour costs to be lower than the elasticity of the number of wage and salary earners with respect to labour costs.

The results reported by Dungey and Pitchford (1998) show that there is no long-run (or short-run) relationship between employment and average hours but, for some reason, they do not discuss this in their paper.¹⁵ This is odd, given that in the text of their paper they explain very clearly why they think average hours worked should be included in the employment equation. They say for example that “the use of employed persons, rather than hours, raises the question of potential substitution between employees and working hours. Firms may choose to pay more for extra hours from existing employees rather than hire more bodies (Hamermesh 1993), and they may choose to hire extra persons on a part-time basis. The Australian labour market has changed over the past two decades, in particular it has become increasingly flexible. One consequence is that additional persons employed may not accurately reflect changes in the hours of labour demanded. In an attempt to account for the changing hours of work, we augment the traditional labour demand equation with an hours-worked variable” (Dungey & Pitchford, 1998, p 220f).

In the models we have looked at in this section we have seen some that make no mention of hours (effectively imposing a long run (and short run) coefficient of zero

¹⁴ In addition to the number of wage and salary earners, total employment includes the number of unpaid family workers and self-employed along with the number of employers.

¹⁵ The coefficient of the change in employment on the level of (actual) hours in their employment equation is -0.015 with an estimated standard error of 0.098 (Dungey and Pitchford, 1998, p 221). However, their sample period is 1984:4 – 1997:1 and it would appear that there was little change in standard and actual hours of work over the period and so, as we shall explain in the next section of this paper, this result is consistent with our theory of the employment – hours relationship.

on hours in the employment equation). We have seen one which allows hours to have a role in the long run relationship but which (perhaps surprisingly) finds a coefficient of zero (Dungey & Pitchford) and another model (to be found in various TYRM papers) which imposes a long-run trade-off between employment and (average) hours of minus unity. For reasons set out in the next section of the paper we find none of these approaches very satisfying. In the next section of the paper we enquire into the long-run relationship which theory suggests we might expect to find between employment and average hours worked and especially ‘standard’ hours of employment. However, before we do that, it may be of interest to have a quick look at historical data on the relationship between average hours worked per week and the number employed. It makes no great difference which employment and hours series we work with, they all convey the same general impression. Figure 1 shows the historical relationship between ‘Total civilian employment’ (in ‘000s) and the index of actual hours worked per week per employee over the period 1965:3 – 2001:3.¹⁶ The rather dramatic leftward shift in the curve takes place over the period 1974:2-1982:3, a period when there were (successful) union campaigns for the extension of 4 weeks annual leave to all employees and then for a reduction in ‘standard hours’ of work in Australia from 40 to 38 (and in some industries to 35). In case the reader might be concerned that a different data set might yield a different understanding of the historical relationship between the two variables we show in Figure 2 the relationship between the ‘Number of non-farm wage and salary earners’ (in ‘000s) and the index of actual hours worked per week per wage and salary earner over the period 1965:3 – 2001:3.¹⁷ The sample period in the Dungey and Pitchford (1998) paper includes only the left-most vertical segment of this figure where, except for very short-lived disturbances, the curve relating employees and hours is vertical – and so it is not

¹⁶ These series and all others used in this paper unless otherwise stated are from the ABS Treasury Model(s) module of the DX database. All series used in this paper have been seasonally adjusted at source. The employment data in Figure 1 is the series VTEQ.AN_NET. The hours data is the series VTEQ.AI_NH. Our sample, period begins at 1965:3 because that is the first date for which we have quarterly data on average hours.

¹⁷ The employment data in Figure 2 is the series VNEQ.AN_NNW. The hours data is the series VNEQ.AN_NHW. Both are from the NIF database in DX. There is a major problem with the average hours series in the NIF database and that is that the marked leftwards shift in the NIF hours series for wage and salary earners ends in 1976 and that for all employees ends in 1979. This is very odd for two reasons. First, it was not until 1981 that the 38 hour week was incorporated into the Metal Industries award and it was 1982 before it entered the Building Trades award and it is strange that the NIF series, unlike TRYM series, does not seem to be picking this up. Second, if we convert the original ABS monthly data on average weekly hours into annual averages it is quite clear that average hours continue to fall into the early 80’s, only ceasing their decline in 1982 (as is recorded in the TRYM average hours series but not the NIF series). We deal with this matter at greater length in a later section of the paper.

surprising then that they find that there is no long-run trade-off between employment and hours.

[FIGURES 1 & 2 NEAR HERE]

Both figures are consistent with a number of hypotheses to be teased out of the model to be developed in the next section of the paper, specifically that: over some periods (periods when standard hours are constant) there is no long-run relationship (trade-off) between hours and employment (the curve relating hours and employment is vertical); that the relationship between employment and hours alters dramatically when standard hours change, and; that in the short-run employment and actual hours are negatively related. In the section which follows we present a very simple neoclassical model of labour services, employment and hours while in section IV we turn to the estimation of a new aggregate employment equation for Australia.

III A Cost-minimizing Model of the Relationship Between the Number of Persons Employed and Average Hours

In this section of the paper we examine the long run relationship between the number employed and both average hours worked and ‘standard hours’ (where standard hours of work are defined to be ‘the number of ordinary hours specified by an award or an agreement beyond which overtime or penalty rates become payable’). For ease of exposition we assume that output is demand determined, that there are no capacity constraints, that the capital stock is given. We will also neglect raw materials so as to concentrate solely on identifying those economic factors which influence the firm’s choice of hours and number of employees.

Labour services and output

Consider a firm which is taking output, (all) prices and its capital stock and technology as given, so that output (Q) is a function of labour services (L) alone, such that

$$Q = AL^\alpha \tag{1}$$

Labour services depend on average hours worked (h) and number of employees (N) so that

$$L = g(N, h) \quad (2)$$

The relationship between L , N and h can be thought of in ‘isoquant’ terms, with there being a map which shows combinations of N and h which yield the same level of labour services (say, L^0L^0 or L^1L^1 in Figure 3). Assuming that the ‘marginal products’ ($\partial L/\partial N$) and ($\partial L/\partial h$) are everywhere positive and diminishing, the iso-labour services curves will be convex and have the usual isoquant form as in Figure 3. (We shall see later that certain restrictions may have to be placed on the labour services function as both the ‘isoquant’ and the relevant budget line turn out to be convex.)

[FIGURE 3 NEAR HERE]

The approach we will follow sees the firm as taking output (Q) and thus the desired level of labour services as given and choosing cost-minimizing combinations of N and h to provide that level of labour services.¹⁸ The nature of the ‘budget-line’ or ‘iso-cost-line’ for labour services however will depend very much upon the model of the costs of labour services we propose. In what follows we neglect fixed costs of hiring or firing as their introduction is unnecessary to make the point we wish to make, that in the presence of a kink in the budget line due to the imposition of a fixed level of standard hours (and overtime payments) the long run coefficient of N on h for a given level of standard hours, will be zero.

The Cost of Labour and Standard Hours

Imagine the cost of labour to the firm depends solely upon the wages paid to labour but that the payment which is made depends upon whether the hours worked are less than or equal to the number of standard hours (hs) or are overtime hours ($h > hs$). The ordinary time wage will be denoted by w and the ‘premium’ paid for overtime as ρ (ie the overtime wage is w (the normal time wage) plus ρ).¹⁹

¹⁸ The approach taken here owes a lot to Rosen (1968), Hart (1984 & 1987) and Hamermesh (1993).

¹⁹ Here and in the later empirical sections of the paper we take the ratio of ρ to w (and implicitly also the ratio of the fixed costs of employment to w) to be fixed.

Total labour cost will be

$$C = wNh + \rho N(h - hs) \quad (3)$$

Under the conditions we have set out above $wh + \rho(h - hs)$ will be the cost of an extra employee (or ‘packet’ of labour) to the firm. The cost of an extra hour to the firm (given the number of employees) will be $w + \rho$ if $h > hs$ and w if $h \leq hs$.

Rearranging (3) gives an expression for N in terms of h

$$N = \frac{C}{wh + \rho(h - hs)} \quad (4)$$

For a given budget (total cost, C) the rate at which the firm can trade the number employed for hours is given by the slope of the budget (ie the iso-cost) line which is the value of dN/dh with C constant.

Consider first the case where no overtime is being worked. If $h \leq hs$ then the term involving the overtime premium ‘drops out’ and (4) becomes

$$N = \frac{C}{wh} \quad (5)$$

Given this, the value of dN/dh (subject to $h \leq hs$) will be

$$\frac{dN}{dh} = -w \frac{N^2}{C} = -\frac{N}{h} < 0 \quad (6)$$

The iso-cost line or budget line in $\{N:h\}$ space will be convex because, if we differentiate (6) with respect to h , we find that $\partial(dN/dh)/\partial h = N/h^2 > 0$ and so the slope of the iso-cost line (dN/dh) will become shallower (less negative), the larger is h (ie the smaller is N). Notice in passing that equation (6) is a rectangular hyperbola and so we should not use $L = hN$ as our specification for labour services (ie as the specific form for equation (2)) because, if we did there would not be any unique values of N and h associated with cost minimisation (for the simple reason that the slope of the

budget line and the iso-labour services line would be the identical,²⁰ regardless of the values of N and h). For there to be a determinate and sensible result the budget line must be less convex than the iso-labour services line.²¹

We turn now to determine the slope of the budget line when actual hours worked exceeds the number of standard hours (ie when overtime is being worked). It would seem that this is empirically the most likely scenario as ABS overtime data²² shown in Figure 4 below indicates that over the whole of the period 1979:3 – 1999:2 the weekly number of overtime hours worked per employee (that is hours of overtime averaged over all employees, not merely those employees working overtime) remained above 1 hour per week even in the depths of the two recessions we experienced over this period.

[FIGURE 4 NEAR HERE]

If overtime is being worked and $h > h_s$ (ie the term in (3) involving the overtime premium ‘remains in’ and we are dealing with (4) rather than (5)), the value of dN/dh will be

$$\frac{dN}{dh} = -(w + \rho) \frac{N^2}{C} = -\frac{N}{h - (\rho/(w + \rho))h_s} < 0 \quad (7)$$

This segment of the iso-cost line will be convex because $\partial(dN/dh)/\partial h = N / (h - (\rho/(w + \rho))h_s)^2 > 0$.

Dividing both the numerator and denominator of (7) by (h) gives us an expression for the slope of the budget line when $h > h_s$ which we can compare easily with the expression for the slope of the budget line when $h \leq h_s$ (this is given in equation (6) above).

²⁰ The slope of both lines would be $-N/h$.

²¹ See Brechling (1965, p 190) for further discussion of this. The TRYM labour demand equation, that posed by Debelle & Vickery (1998) and the aggregate hours equation in Lewis & MacDonald (2002) all seem to us to potentially suffer from this problem.

²² Source of data is the DX ABS Time series database Table 6354-4A.

$$\frac{dN}{dh} = -\frac{N}{h} \left(\frac{1}{1 - (hs/h)(\rho/(w + \rho))} \right) \quad (8)$$

Since both hs/h and $\rho/(w + \rho)$ are positive and less than 1, the value of the slope as given by (8) will be steeper (more negative) than will the slope as given by (6), for the same values of N and h . Indeed, since the number of overtime hours is often only a very small fraction of total hours (and thus hs is ‘large’ relative to total hours h) the slope in the case when overtime is being worked (equation (6)) will likely be ‘quite steep’ compared with the slope of the budget line where hours worked are less than or equal to standard hours (equation (6)). Importantly, this implies is that there will be a pronounced ‘kink’ in the budget or iso-cost line at the point where $h = hs$ and this in turn is likely to have the result that firms will tend to choose combinations of N and h involving values of h that are close to ‘standard hours, since that is where the ‘kink’ occurs.²³ This is depicted in Figure 5 where the solid line indicates an iso-labour services line and the broken line an iso-cost or budget line.

[FIGURES 5 & 6 NEAR HERE]

In the absence of a change in standard hours one would expect as scale (Q) and thus N varies over time for the expansion path to lie along the vertical straight line depicted in Figure 6. This conclusion of ours is reinforced by the argument that “it makes sense that ... the firm’s optimal hours be independent of scale. There is no evidence that weekly hours of full-time workers at General Motors differ substantially from hours of workers at the local street fabricator” (Hamermesh, 1993, p 50).²⁴ Indeed, we shall see that, as a stylised fact, it does seem appropriate to propose that, for given standard hours, the expansion path for employment is vertical and that hours are invariant to scale (Figures 1 and 2 above are also supportive of this hypothesis).

²³ Other explanations for a vertical expansion path come to mind. For example, if the iso-labour-services line were to turn upwards (perhaps because, contrary to our assumptions, dQ/dh could be negative and indeed become negative) near or just past the point where $h = hs$. This could also explain the choice of (average) hours close to or just above standard hours. Carter & Maddock (1984) explore this matter in some detail.

²⁴ Hart (1984, p 68 and 1987, p 74) argues that “equilibrium hours are scale-independent”. Rosen (1968, p 516) simply assumed that the equilibrium value of (average) hours is independent of the level of labour services.

All of which is to say that unless actual hours are varying with a change in equilibrium or standard hours, actual hours should not appear (or should not appear with a non-zero coefficient) in the long-run component of an equation for employment. If however standard hours are changing then it is desirable that this be incorporated into the long run component of the employment equation.

Changes in standard hours

If standard hours (alone) were to change, what can we say about the likely effect of this on employment (cet par)?

We begin by noting that if $h > hs$, then (4) may be written as:

$$N = \frac{C}{whs + (w + \rho)(h - hs)} = \frac{C}{(w + \rho)h - \rho hs} \quad (4')$$

Differentiating (4') (or (4)) with respect to hs , we find that

$$\frac{dN}{dhs} = \rho \frac{N^2}{C} = \rho \frac{N}{(w + \rho)h - \rho hs} > 0 \quad (9)$$

which is to say that a lengthening of standard hours where the firm wishes to maintain the level of labour services constant will result in the firm hiring more employees (and reducing overtime).²⁵ This is because hiring more employees is now more attractive, at the margin, than increasing hours for existing employees. One way to see this is to think of the cost of an extra employee as the cost of a 'packet' of labour services with the cost being $w + \rho(h - hs)$. If hs rises with h given, the cost of the 'packet' of labour services falls relative to the cost of an extra hour beyond hs because a larger proportion of an employee's hours can now be purchased at a cheaper rate. The

²⁵ An alternative approach would be to ask about the effect on the slope of the budget line (as depicted in our Figures) of a change in hs . Differentiating (7) with respect to hs (assuming, inter alia, that h is constant) yields: $\partial(dN/dh)/\partial hs = -\rho(w + \rho)(N^3/C^2) < 0$. Which is to say that (cet par) an increase in (a lengthening of) standard hours results in the slope of the budget line becoming steeper (more negative) and, as a result, there will be a tendency for N to rise (and h to fall). This is the same prediction we arrived at in the text. It should be noted that we are assuming throughout that the firm is in the region where overtime is being worked. If that is not the case the effect of a change in standard hours on employment will depend upon whether actual hours are equal to or below the new level of standard hours. Hamermesh (1993), Hart (1984 & 1987) and Hart & Wilson (1988, p 176) find that empirically dN/dh is greater than zero for firms working overtime.

reverse will be true for a fall in hs given h . A fall in hs will (cet par) induce a fall in N (as the cost of a ‘packet’ of labour services has increased) and a rise in overtime.²⁶

Can we say anything about the likely size of the (output and wage constant) elasticity of employment with respect to standard hours? Multiplying both sides of (9) by hs/N gives an expression for the elasticity of:

$$\frac{dN/N}{dhs/hs} = \frac{1}{((w + \rho)/\rho)(h/hs) - 1} > 0 \quad (10)$$

Since both terms in parentheses on the RHS of the denominator are greater than 1 the elasticity will not only be positive but also be less than 1.

We may take this a little further. If we can assume that h/hs is approximately equal to 1,²⁷ the elasticity of employment with respect to standard hours in equation (10) will be approximately equal to

$$\frac{dN/N}{dhs/hs} \approx \frac{\rho}{w}$$

Since (a small amount of) overtime is often paid at ‘time and a half’²⁸ we may say that the value of the elasticity of employment with respect to standard hours is not only going to lie in the interval between 0 and 1 but is likely to be in the order of $\frac{1}{2}$.

Aggregation over firms working different hours

Thus far we have assumed that there is a single representative firm with (all) employees working overtime hours. In reality some firms will be working above standard hours, some working exactly standard hours and some will be working less

²⁶ We have assumed scale is unaffected by the change in standard hours, but there is every reason to believe that, absent an equi-proportionate or more than equi-proportionate reduction in the nominal wage (or rise in productivity), as standard hours fall ‘scale effects’ will reinforce the ‘substitution effect’ and lead to a reduction in numbers employed.

²⁷ Data on the DX ABS Time series database Table 6354-4A indicates that over the period 1979:3 – 1999:2 the mean number of overtime hours worked per employee (not merely those employees working overtime) was 1.24 hours per week. If standard hours were (say) 38 then the ratio of h to hs would be in the order of 1.03, ie close to 1.

²⁸ And so $\rho = \frac{1}{2} w$.

than standard hours.²⁹ In a more general model where some firms are in an overtime regime and while others are not, a drop (say) in standard hours will cause some firms to lower employment (this is the case we examined above), some would not alter the number they employ (this would be the case for firms whose hours of work are low enough that they are below standard hours even after standard hours have fallen), while some might increase employment following a fall in standard hours (this would be the case for firms which always operated at standard hours whatever they happened to be and, when faced with the same demand for labour services but lower average hours per worker will raise employment to compensate for the fall in hours).³⁰ So although modellers usually focus on the case we have looked at above (where overtime is being worked) and empirically we do observe that on average across employees overtime is being worked, we must accept that in the more general case, “in which some firms are in an overtime regime while others are not ... the effect of a change in standard hours becomes ambiguous” (Hamermesh, 1993, p 53f). Thus, although we will maintain the hypotheses derived in the previous section that the elasticity of employment with respect to standard hours is positive but less than one, (we maintain this hypotheses because it is the case that overtime is worked on average), we do none-the-less accept that the effect of a change in standard hours on the number of persons employed in the economy as a whole is complex and essentially becomes an empirical issue.

The relationship between employment and hours in the short-run

It is reasonable to argue that in the short run firms respond to demand/output shocks by initially adjusting average hours worked relative to the number of persons they employ. This notion is given theoretical support by Walter Oi (1962) and Sherwin Rosen (1968) amongst others. For example, Rosen (1968, p 517) has argued that it is an implication of the presence of fixed costs of employment that, “it is a clear implication of the fixed cost hypothesis that marginal costs of changing employment relative to changing hours of work per man will be higher the shorter the period of change and the larger are specific investments” (Rosen, 1968, p 518). Given this, if scale falls (cet par) we would expect to see a fall in hours relative to N at least initially

²⁹ In addition within any one firm some employees may be working overtime hours while others are working standard or less than standard hours.

³⁰ Hart (1987, p 99f) has a neat discussion of the various cases as has Hamermesh (1993, p 53f).

then a fall in N and a recovery of the original h . So the path to be followed in N, h space is rather reminiscent of the path we describe in inflation:unemployment rate space for a downwards shock: initially leftwards towards the trade-off curve then rightwards down the trade-off curve to where it intersects the vertical long-run curve. See Figure 7 for an example. Imagine initially equilibrium was at point X in the diagram and that there is an unanticipated permanent decrease in demand for the product and thus in the demand for labour services from L^1L^1 to L^0L^0 . Initially the firm will cut h relative to N , (say) moving from point X towards Y. As adjustment continues the firm will move from point Y to Z, with the same standard hours being worked as before but with a lower number employed.

[FIGURE 7 NEAR HERE]

Thus far in this section of the paper we have looked at employment determination from the point of view of the cost function. In the next sub-section we show what our approach implies from the point of view of the production function.

Nested CES Production and Labour Services functions

The view we have of the production and input demand relationship can be set out as follows. Firms produce output (Q) with the aid of labour services (L) and capital goods (K) and a level of technology (A). Labour services in turn are a function of the number of employees (N) and the number of hours worked per employee (h). In symbols

$$Q = f(K, L, A) \tag{11}$$

$$L = g(N, h) \tag{12}$$

In what follows we assume that the production function which relates output to labour services and capital goods is CES in form and that within this is nested a CES labour services function which relates labour services to the number of employees and average hours worked.³¹

³¹ On nested CES models see Dixon and Rimmer (2002, pp 161-9).

Assuming competitive behaviour and constant returns to scale, profit maximization implies that equation (11) yields the following expression for the percentage change in labour services³²

$$l = q - a - \sigma_{LK}(p_L - p) \quad (13)$$

where l is the percentage change in labour services

q is the percentage change in real output

a is a trend term incorporating, inter alia, the rate of technological change

p is the percentage change in the price of real output

p_L is the percentage change in the price of one 'bundle' of labour services

σ_{LK} is the elasticity of substitution between labour services and capital

Equation (13) says, as we would expect, that the rate of growth in the demand for labour services is related to the rate of growth in real output (with an elasticity of 1), the rate of technological change³³ and the rate of growth in the real price of labour services ($p_L - p$), with an elasticity of substitution between labour services and capital (σ_{LK}). Notice in passing that, since the output price (p) will be a weighted sum of the prices of the two inputs, ($p_L - p$) will be equal to, greater than or less than zero depending upon the relative rates of change of the price of labour services and the user cost of capital.

We turn now to labour services. Assuming labour services is related to N and h in a CES fashion, analogous reasoning to that used above yields the following expression for the percentage change in the number of employees

$$n = l - \sigma_{Nh}(p_N - p_L) \quad (14)$$

where n is percentage change in the number of persons employed

p_N is percentage change in the cost of an employee

$p_N - p_L$ is percentage change in the cost of employees relative to the price of a bundle of labour services

³² In what follows all variable are expressed in percentage change form.

³³ In principle both (13) and (14) could have technological change terms in them.

σ_{Nh} is the elasticity of substitution between number of persons employed and hours of work per employee

Substitution of (13) into (14) gives

$$n = q - a - \sigma_{LK}(p_L - p) - \sigma_{Nh}(p_N - p_L) \quad (15)$$

which is to say that the percentage change in the number of persons employed depends upon the percentage change in real output (q), the rate of technological change (incorporated in a), the percentage change in the cost of an additional employee relative to the price of a 'bundle' of labour services ($p_N - p_L$), the percentage change in real cost of labour services ($p_L - p$) and the size of two elasticities, the elasticity of substitution between labour services and capital goods (σ_{LK}) and the elasticity of substitution between the number of persons employed and hours of work per employee (σ_{Nh}).

Notice in passing that since the price of a bundle of labour services (p_L) will be a weighted sum of the prices of the two inputs to labour services (persons and hours) and that ($p_N - p_L$) will be equal to, greater than or less than zero depending upon the relative rates of change of the cost of an additional employee and the cost of an additional hour of work. Earlier in this section of the paper we saw that (if overtime is being worked) the cost of an additional hour of work is ($w + \rho$), where w is the ordinary time wage and ρ is the overtime premium, and that the cost of an additional employee³⁴ (given hours of work) is $wh + \rho(h - hs)$, which can be written as $(w + \rho)h - \rho hs$. An expression for the cost of an additional employee relative to the cost of an additional hour will therefore be:³⁵

$$\frac{(w + \rho)h - \rho hs}{(w + \rho)} = h - \left(\frac{\rho}{(w + \rho)} \right) hs \quad (16)$$

³⁴ We are assuming here that there are no fixed costs of employment. If there are, a component representing the fixed costs per employee should be added on to the expression.

³⁵ Again, if there are fixed costs of employment an additional (constant) term is added on to the numerator of (16). If no overtime is being worked (16) reduces to h alone.

Equation (16) tells us that the relative price of an extra employee relative to an extra hour, and thus the size and sign of $(p_N - p_L)$, will depend upon the level of standard hours (given actual hours) and the size of the overtime premium relative to the ordinary time wage rate. In effect, an increase in standard hours, given that overtime is being worked, is to reduce the cost of an additional employee relative to the cost of an additional hour. This is consistent with the result found earlier when we looked at the cost function. Amongst other things, this indicates that an employment equation which includes only the first three items on the RHS of (15), is likely to be misspecified and will result in a biased estimate of σ_{LK} if $(p_N - p_L)$ is both varying over time and is correlated with $(p_L - p)$. It is because we believe this might be the case that we have a number of times in the text suggested that estimates of the elasticity of substitution of labour for capital arrived at by fitting an employment equation which includes only the first three terms on the RHS of (15) to data which includes the 70s and early 80's (when standard hours were changing) are likely to have yielded biased estimates of that elasticity. Further, equation (16) provides additional motivation for our estimating equation which includes not only the first three terms on the RHS of (5) but, in addition, also allows for changes in standard hours as a proxy for the last term on the RHS of (5).³⁶

In this section of the paper we have set out a highly stylised model of employment and hours. In the section which follows we estimate an employment equation for Australia over the period 1966:3 – 2001:3. We begin by setting out specific hypotheses in relation to employment and hours which should be subject to test.

IV Empirics

Given the survey of empirical work set out in Section II and the thrust of the model set out in the previous section, it is possible to set out a list of quite specific issues and hypotheses to be explored empirically. These are:

³⁶ It also provides an additional explanation for the link between the relative size of the overtime premium and the elasticity of employment with respect to standard hours.

1. That standard hours should be included in the employment equation but if they are not changing there will be no association between the number employed and hours (actual or standard) in the long-run.³⁷
2. If standard hours are changing, we would expect, *cet. par.*, that in the long run this will result in a change on the number employed. Given that the majority of firms are in the overtime regime³⁸ we predict that the number employed will change in the same direction as standard hours with an elasticity which is positive but less than unity and likely around ½ or less.
3. In the short run, employment and (actual) hours will be negatively related.
4. If hours are relevant to the employment equation but are not included (or are included but with an imposed parameter value that is incorrect) then it may be that estimates of the other parameters in the employment equation (such as the elasticity of employment with respect to the real wage – that is the elasticity of substitution (σ) – will be biased.

All in all, these seem to be strong and clearly specified hypotheses which flow from our model and are capable of refutation.

Stylised Model

In developing an estimable model for the (derived) demand for employment, several options might be followed. One way to look at what we are doing is to see that our primary purpose is to consider the role of standard hours in the employment equation and, to that end, guided by economic theory as well as past empirical work, we include the real wage, output and a time trend as control variables. Alternatively our estimating equation can be seen as the reduced form of a more elaborate model of hiring. A formal model of a representative firm's optimisation problem would involve maximisation of profits subject to explicit functional forms for the production function subject to a budget constraint with exogeneity assumed in wages, the overtime premium, standard hours, capital assets and product price (or explicit input

³⁷ Since standard hours were relatively stable during the sample period examined by Dungey & Pitchford (1998), we see their result that employment and hours are unrelated in the long run as being consistent with our hypothesis.

³⁸ If firms are not in the region where overtime is being worked the effect of a change in standard hours on employment will depend upon whether actual hours are equal to or below the new level of standard hours. (See the closing parts of section III for more discussion of this.)

supply and output demand functions). Instead we will use a reduced form expression for long run or desired employment (N), as a function of the real wage, real output, standard hours of work and a time trend to capture the effects of technological change and other (trended) omitted variables. We are implicitly assuming a constant overtime premium relative to the normal time wage (and that any fixed costs of employment relative to the variable costs of employment are also constant) – to assume otherwise would mean that the hours-number of persons relationship will change in the long run. We make these assumptions due to the absence of adequate time series data on these items. Leaving issues related to the dynamics of the relationship to one side, our estimating equation then will have the logarithm of employment on the LHS and the logarithms of the real wage, output and standard hours on the RHS, together with a time trend.

Data

Figure 8 below sets out data for (the logarithms of) real non-farm GDP at market prices (this is series VNEQ.AVCH_GTM in the NIF database in DX), the number of non-farm wage and salary earners employed (this is series VNEQ.AN_NNW in the NIF database in DX) and the real wage. The real wage is measured as the average earnings of non-farm wage and salary earners (national accounts basis³⁹ - this is series NNEQ.AC_WARSS\$ in the NIF database in DX) adjusted for Payroll Tax⁴⁰ deflated by the price index for gross non-farm product at market prices (this is series VNEQ.AICH_PGNM in the NIF database in DX). We look at the employment of wage and salary earners for two reasons. First, that was the dependent variable in the most recent published study for Australia by Lewis and MacDonald (2002) and we are keen to facilitate comparisons between our study and that one. Secondly, given the nature of our theoretical model, it is the employment of wage and salary earners rather

³⁹ This means that this series includes wages, salaries, and supplements such as worker's compensation, superannuation

⁴⁰ Payroll tax has not been levied at a constant rate over the period. In particular there were marked increases in the early and mid 70s. The adjustment for payroll tax has been made by taking figures for total payroll tax paid per quarter from the NIF database (series VNEQ.AC_TPR\$) dividing this by the number of non-farm civilian wage and salary earners, converting the result to a figure in dollars per employee per week and adding that on to the figure for average earnings of non-farm wage and salary earners on a national accounts basis. The payroll tax adjusted wage series diverges 'slightly' from the average earnings series in the early and mid seventies but apart from that the two are very highly correlated ($r = 0.999$ for the whole of the period).

than all persons employed (which would include unpaid family workers, self-employed and employers), which seems to us to be the most relevant.⁴¹

[FIGURE 8 NEAR HERE]

As our quarterly series for average hours we use the TRYM measure for actual weekly hours worked (this is series VTEQ.AI_NH in the TRYM database in DX). An advantage of the TRYM series is that it adjusts the ‘raw’ ABS data (which is extremely noisy) for average hours worked “to account for outliers that appear to be due to show day holidays affecting the hours worked data in particular months (identified via a detailed check of the Labour Force Survey disaggregated hours worked data). The effect of this adjustment is to remove a number of large spikes in the data which might otherwise lead to negative auto-correlation in the dynamics” (Downes and Bernie, 1999, p 53). In our judgment the TRYM series is a far more faithful quarterly version of the raw hours data than is the NIF hours series. The actual hours worked series from TRYM (in index number form) is given as the solid line in Figure 9. We see there that actual hours worked per week fell markedly over the period 1973/4 – 1977/8 and then fell again in the early 80’s. Since then it has been relatively constant.⁴²

We turn now to the quarterly series for standard hours. Unlike many European countries, in Australia there is no legislation or statute setting a limit on hours of work. However both awards and determinations have in the past had much to say about ‘standard’ or ‘ordinary’ hours of work. For example: the 40 hours week was introduced into awards in 1947/48 (prior to that period it had been 44);⁴³ over 1973/74 four weeks annual leave was extended to virtually all employees; in 1981 the 38 hour week was incorporated into the Metal Industries award and in 1982 it entered the

⁴¹ At the beginning of our sample period wage and salary earners made up around 88½ % of all employed while at the end of our sample period it was around 87½ %.

⁴² Actual average hours worked have been stable in part because the rise in the proportion of those employed who are working part-time (and which would have been pulling average hours worked by all employees down) has been accompanied by a (marked and sustained) rise in the average hours worked by full-time employees. Graph 3 in Lester (1999) suggests that average hours worked by full-time workers was constant over the period 1993-1999.

⁴³ In the 1952/3 Basic Wage and Standard Hours enquiry private employers sought to have standard hours returned to 44 hours per week. In 1961 private employers sought to have standard hours raised to 42 hours per week. (Both applications were refused.)

Building Trades award.⁴⁴ This (38 hours) “gradually became the standard throughout many industries over the course of the 1980’s, though a 35 hour week does exist in a number of industries including coal mining, oil and stevedoring, and Commonwealth public servants have worked a 36.75 hour week since 1902” (Wooden et al, 1994, p 4). We have defined standard hours above as ‘the number of ordinary hours specified by an award or an agreement beyond which overtime or penalty rates become payable’. However, what ‘standard hours’ amount to in practice depends not only upon agreed ‘ordinary’ working hours but also upon leave entitlements, the number of public holidays and whether those public holidays fall on a weekend or not. A number of writers have attempted to develop a series for standard hours with and without adjustments for leave entitlements and/or leave taken,⁴⁵ the most recent being given in Wooden et al (1994). Fortunately there seems to be a good deal of agreement on the timing and the direction of movements in standard hours, at least until the (partial) deregulation of the labour market in the 1990s. We begin with a description of the main trends in standard hours for the period from 1965 up to the middle of the 1990s. Standard hours were roughly constant or falling slightly over the period 1965 – 1972, there was then a relatively steep fall between 1972 and 1978, a slight pause and then further falls until 1984 or 1985 after which it has been relatively stable. (We shall have more to say about hours since the mid 90s below.) The reader will notice that this account is very similar to a description one might give of the behaviour of average hours actually worked over the period (see for example the series given by the solid line in Figure 9) and indeed many authors have remarked on the fact that the ‘trend’ in actual hours has tended to mimic the movement of standard hours,⁴⁶ as the theory set out in the previous section would predict. Indeed this gives rise to the notion that standard hours are an ‘attractor’ for actual hours and that a series for standard hours can be arrived at by fitting a trend (eg a logistic trend as in TRYM) to the series for actual hours. Equilibrium hours worked in TRYM are determined by a

⁴⁴ One reason why we favour the TRYM series over the NIF series is that neither of the series provided by NIF shows signs of any marked and permanent decline in the early 80’s and yet we know that it was in this period that the 38 (and in some awards, the 35) hour standard work week was spreading across industries.

⁴⁵ These include Butlin (1977), Linacre (1980), Steinke (1983), Bureau of Industry Economics (1984), Carter & Maddock (1984) and Wooden et al (1994). Raw data for standard hours for a full-working week according to “awards, determinations or collective agreements” were published by the ABS in the *Labour Report*, Cat. No. 6.7 and more recently in *Award Rates of Pay Indexes, Australia*, Cat. No. 6312.0.

⁴⁶ At least until, the mid-1980’s – see Dawkins & Simpson (1994, p 14) and Wooden et al (1994, p 5) for example.

logistic equation the form of which shows that equilibrium hours are falling from 1971:3 until 1983:3 and are constant after that date.⁴⁷ This movement “reflects the sharp movement down in the mid-1970’s due to the move to 35 hours as the standard work week” (Downes and Bernie, 1999, p 45). The broken line in Figure 9 sets out the TRYM index of ‘equilibrium hours’ (this is series VTEQ.AI_NHLR in the TRYM database in DX) over the period 1965:3 – 2003:1. The TRYM series has two advantages when used as a series for ‘standard hours’: First, its profile is consistent with other evidence on standard hours and the outline of the main influences given above. Second, it has the additional advantage that it is the trend in, and thus an ‘attractor’ for, the actual hours of work series.

[FIGURE 9 NEAR HERE]

The TRYM equilibrium hours series we are using as a proxy for standard hours has been constant throughout the 90’s. There are reasons to view the notion that standard hours have been constant through the latter part of that period, in particular, with some caution. Indeed, it could be argued that, at least since the mid 90’s the very notion of ‘standard hours’ as a summary device is open to question at least since November 1996, when the *Workplace Relations Act 1996* came into force.⁴⁸ Our position is as follows: At least up until the mid-1990s we think it unobjectionable that the stylised model of employment presented in the previous section of the paper is appropriate. Further, we think a case can be made for us to hold, at least as a hypothesis capable of refutation, that the stylised model can be applied (ie standard hours have persisted at an average level of 38 or so) beyond 1996,⁴⁹ and we provide the following arguments in support of this hypothesis. First, at least one employer body sees it that way. The chief executive of the Australian Chamber of Commerce

⁴⁷ The logistic curve is centered on (ie has its point of inflexion at) 1976:3. It involves fitting the equation $hs = hsT + (\Delta hs / (1 + \text{EXP}(b(t - t^*))))$, where hs is standard hours (= ordinary time hours) at any date, hsT is standard hours (= ordinary time hours) at the end of the sample period (Δhs is $hsT - hs_0$ and so $hsT + \Delta hs = hs_0$) and t is an annual time trend with a value of 1 in 1965. If $t = t^*$ then $hs = hsT + \frac{1}{2}(\Delta hs)$. As t tends to + infinity hs tends to hsT while as t tends to - infinity hs tends to $hsT + \Delta hs$.

⁴⁸ A good summary of the history of deregulation can be found in Briggs & Buchanan (2000). We refer to 1996 as the (possible) watershed on the basis of Wooden’s assertion that: “Enterprise agreement-making ... only became widespread after the introduction of the *Industrial Relations Reform Act 1993* (which came into force in March 1994). Further, many of the other regulatory reforms often highlighted as exacerbating trends towards longer working time ... only assumed any significance after the introduction of the *Workplace relations Act 1996* (Wooden, 2003, p 260).

⁴⁹ Or beyond the introduction of the *Industrial Relations Reform Act 1993*, which came into force in 1994.

and Industry is reported as saying as recently as 2002 that: “Most industrial awards continue to prescribe not only the maximum number of ordinary hours per week (38 in many private sector awards), but still specify patterns of work; times of breaks; and rostering arrangements. The process of award simplification – whereby the Australian Industrial Relations Commission itself had to wind back excessive award regulation to specified minima only – has only made a marginal difference. Working hours continue to be over-regulated at a central level.” Hendy (2002, p 3). Second, it would appear that 38 hours (the ‘old’ award level of standard hours in most private sector industries) has been carried over as the typical benchmark in agreements. The Australian Centre for Industrial Relations Research and Training (ACIRRT) Agreements Database and Monitor (ADAM), has information on 9,198 registered enterprise (collective) agreements from the Federal and State jurisdictions. The ADAM Database also holds information on federal Australian Workplace Agreements. We are advised by the ADAM Database Coordinator (Nicola Parsonage - pers. communication) that “the range for ordinary time is somewhere between 35 and 45 hours per week but it is reasonable to say that 38 hours is the standard and that, in general terms, any hours in addition to this would be seen as overtime hours”. Buchanan et al (2001, p 43) in their survey of working time arrangements in enterprise agreements current in 2001 (the last year in our sample period) report that “a “majority [of agreements] state that ordinary hours are 38 per week [as] many provisions simply mirror what’s in the Award”. Third, we have earlier argued that standard hours are an attractor for actual hours and so it is reasonable to take into account other information on actual (ordinary time) hours over the past decade. Since 1974 the ABS has conducted a survey of employers which collects (inter alia) information on the number of hours worked each week which are paid for at the ordinary rate (hence their description of these hours as ‘ordinary time’).⁵⁰ The data of most relevance to our study is that for the ordinary time hours of adult *non-managerial employees* who are employed full-time (our emphasis). The term non-managerial indicates that the data “excludes managerial, executive, professional and higher supervisory staff”. Ordinary time hours paid for are defined as: “Award, standard or agreed hours of work, paid for at the ordinary time rate.” Notice that the information is not restricted to employees covered by awards. Unfortunately although

⁵⁰ These estimates are to be found in ABS 6306.0 - *Employee Earnings and Hours, Australia*.

it was conducted annually until 1998 the most recent surveys are for 2000 and 2002 but the main features of this data are consistent with our ‘as if’ hypothesis. According to the survey data, ordinary time weekly hours (this is a weighted sum of the data for males and females – although for full-time employees there is relatively little difference between ordinary time hours for males and females in most years) were 38.5 in 1974, falling to 38.4 by 1977 and then to 38.3 in 1980, 38.1 in 1983 and to 37.8 in 1984. It dipped to 37.7 in 1989 and 1990 and then rose to 37.9 in 1992 where it remained until 1998 when it rose again to 38.0. In 2000 it was 38.0 and, in 2002, 37.9. So after a fall in the early 80’s, it would appear that ordinary time hours for adult non-managerial employees have been fairly stable at around 38 hours.⁵¹ To summarise our thoughts on standard hours since the mid-nineties: doubtless ‘non-standard’ employment has been growing in recent years however, in the search for a parsimonious model capturing the essential features in a single employment equation, whether this is seen as useful in its own right or merely as the first step to a more sophisticated analysis, we believe it is appropriate to maintain the ‘standard hours’ notion, whether as a ‘stylised fact’ or as an ‘as if’ hypothesis, beyond the mid 90’s.⁵²

Our Findings

All of the series we are interested in are I(1) over our sample period.⁵³ Set out below are the results of using EViews to estimate an error correction model with the change in the logarithm of employment (*LN*) as the dependent variable and with a time trend (*TREND* - to pick up technological change) and the logarithms of the real wage (*LRW*), production (*LY*), standard hours (*LHS*) and actual hours (*LHA*) as explanatory variables.⁵⁴ Standard hours enter into the long run portion of the equation while actual

⁵¹ The information given here is consistent with rising actual hours on the part of full time employees for two reasons. First, we are talking about ‘ordinary time hours’ not actual hours. Second, it appears to be the case that while those “working extended hours includes employees from all major occupational groups [the] highest proportions [are] managers and administrators, professionals and associate professionals” (Campbell, 2002, p 96). The 2001 Census also shows that “Very long working hours are more common among workers who are self-employed [and employers] than among employees” (ABS, *Social Trends*, Cat. No. 4102.0, 2003, p 120). It also appears that there has been considerable growth in ‘unpaid’ overtime (Heiler (1998) and Campbell (2002)).

⁵² Another way to put it would be to say that we are proceeding under the assumption that firms have behaved post 1996 “as if” standard employment were the rule. (For a defence of the “as if” approach – which is not without its critics - see Friedman (1953)).

⁵³ This should be obvious from looking at the various charts we have provided. Formal unit root tests confirm this visual impression.

⁵⁴ A VECM was first estimated for the variable set (*LN*, *LY*, *LRW*, *LHS*, *TREND*). The LR test that *LRY*, *LRW* and *LHS* are exogenous was not rejected at the 5% level of significance.

hours only enter into the short run dynamics. The employment equation for the sample period⁵⁵ 1966:3 – 2001:3 is⁵⁶

	<u>Coefficient</u>	<u>Std error</u>	<u>p-value</u>
Constant	-0.2725	0.2078	0.1919
Error Correction Parameter	-0.2534	0.0373	0.0000
<u>Long run components</u>			
<i>LY</i>	1.0715	0.1050	0.0000
<i>LRW</i>	-0.3414	0.0754	0.0000
<i>LHS</i>	0.4573	0.1413	0.0015
<i>TREND</i>	-0.0032	0.0008	0.0000
<u>Short run components</u>			
<i>D(LY)</i>	0.3007	0.0570	0.0000
<i>D(LRW)</i>	-0.0824	0.0406	0.0446
<i>D(LHA)</i>	-0.1843	0.0680	0.0008

The implied long-run values of the coefficients (the long run elasticities) are as follows: the elasticity of employment with respect to non-farm GDP (which we take to be an estimate of the degree of returns to scale⁵⁷) is 1.07, the elasticity of employment with respect to the real wage⁵⁸ (which we take to be an estimate of the elasticity of substitution) is 0.34 and the elasticity of employment with respect to standard hours is 0.46. The Long run coefficient on the time trend (-0.0032) yields an estimated annual rate of technological progress of 1.9% per annum.⁵⁹

⁵⁵ The earliest period for which we have quarterly hours data in DX is 1965:3 however examination of the data showed marked instability in the first few observations. For that reason we have chosen to use 1966:3 as the first period in our study.

⁵⁶ Both the Schwarz Criterion and the Hannan-Quinn Criterion support a zero lag order. Residual diagnostics show that the residuals are well behaved in that neither autocorrelation nor ARCH is present and there are no departures from normality. Essentially the same results are arrived at if we use as the real wage a measure which has not been adjusted for payroll tax.

⁵⁷ A worrying feature of many earlier studies of the employment equation is their finding that returns to scale are not constant. Here, the hypothesis that the elasticity of employment with respect to output is 1 is not rejected at the 5% level of significance.

⁵⁸ If we restrict our sample period to 1984:4 on (the start of the period looked at by Dungey & Pitchford (1998)), the estimate of the elasticity of substitution is 0.42 with a standard error of 0.10.

⁵⁹ As Ferguson (1965), Dowrick & Wells (2003) and others have shown the coefficient on the time trend in the employment equation is not itself an estimate of the rate of technological progress, it is instead equal to $-(1 - \sigma)\lambda$, where σ is the elasticity of substitution and λ is the rate of technological progress. Our figure for the annual rate of technological progress is arrived at by dividing 0.0032 by 0.66 (ie by $1 - 0.34$) and multiplying the result by 4.

Of some importance is the significance, sign and size of the coefficient on standard hours. The sign on this variable is consistent with our hypothesis that we can view the aggregate as if it were a single firm operating in the overtime region. The size is consistent with our hypothesis that the elasticity of employment with respect to standard hours (given that firms are operating in the overtime region) will be approximately equal to the overtime premium expressed as a proportion of the normal time wage. A Wald test decisively rejects the restriction that the coefficient on standard hours is zero.

The error correction term suggests that a little over $\frac{1}{4}$ of any disequilibrium is corrected in any quarter.⁶⁰ The short run elements have sensible signs and we note that there is a negative relationship as we have hypothesised between actual hours and employment in the short run. In addition to the partial adjustment of employment in relation to any gap between actual and desired (long-run equilibrium) employment, the change in employment responds positively to a short-run change in output, but with an elasticity of 0.3, it responds negatively to the change in real wages with a low elasticity of -0.08 , and it is slowed by any change in current hours.

One other feature of our results is that our estimate of the elasticity of substitution is below that reported by Lewis & MacDonald (2002), consistent with our conjecture earlier that by neglecting standard hours their estimate of the substitution elasticity would be biased upwards. Indeed, if we estimate an employment equation for the same sample period (1966:3 – 2001:3) and variables as those we have reported above but without including standard hours (so the only variables in the long-run component of the model are those included by Lewis and MacDonald – ie output, real wages and a time trend) we find that the long-run elasticity of substitution is estimated to be 0.476, well above what we find when standard hours are included.

Figure 10 shows the cumulative effect upon employment of a 1% increase in non-farm GDP (upper line) and a 1% increase in the real wage (lower line).

⁶⁰ The significance of the error correction term (and also the fact that it has the correct sign and that it lies between 0 and 1) indicates that the variables are cointegrated. Since the set of long-run explanatory variables includes the deterministic term *LHS*, the error correction test for cointegration was based on the critical values given in Ericsson & MacKinnon (2002). The Johansen test was also applied and it confirmed the presence of only one cointegrating equation.

[FIGURE 10 NEAR HERE]

We think it important, given the history of the Australian wages and (un) employment policy debates in recent decades, to consider possible asymmetric effects on employment of changes in output (and other variables which enter into the employment equation).

Testing for asymmetries

It is of interest to consider the possibility that employment might display some asymmetric response to changes in its determinants and, most especially, if the behaviour of employment in periods of downturn when the economy is moving into recession is different to that in non-recession periods.⁶¹ One reason why we expect this is that when the economy is in recession not only are there many firms which are forced to close business, but managers of firms which ‘survive’ are under considerable pressure to rationalise their business operations, and society, including labour unions, are less resistant to dismissals which are widespread and are perceived to be necessary for the firm to survive. Our test for asymmetries involves introducing dummy variables which have a value of 1 if the period is a period of recession⁶² and 0 otherwise in such a way that the size of a coefficient in the regression equation might be higher or lower in a recession period than otherwise. We began by hypothesising that the asymmetries may affect the constant term, the error correction parameter and the short run coefficients on output, the real wage and hours. Wald tests showed that the only significant asymmetry was in relation to the error correction parameter. The employment equation for the same sample period as that considered earlier (1966:3 – 2001:3) and for the same dependent variable $D(LN)$ as estimated earlier but now with a time varying error correction parameter is:⁶³

⁶¹ There are a number of reasons why one might be interested in this but a dominant motivation for us is the observation that unemployment has risen rapidly in recessions but declines only slowly during recoveries. Evidence from gross flows data (see for example Debelle & Swann (1998) and Leeves (1997)) suggests that an important contributing factor (but by no means the only contributing factor) to this rapid rise in unemployment is the marked increase in flows from employment to unemployment in recession episodes.

⁶² Following the latest estimates by Boehm & Summers (1999, Table 4), there are only two (classical) downturns in GDP over the time frame we are considering. Those two periods are 1982:1-1983:1 inclusive and 1990:1-1991:1 inclusive.

⁶³ Again, the sample period is 1966:3 – 2001:3. Residual diagnostics show that the residuals are well behaved in that neither autocorrelation nor ARCH is present and there are no departures from normality.

	<u>Coefficient</u>	<u>Std error</u>	<u>p-value</u>
Error Correction Parameter	-0.2277	0.0266	0.0000
Adjustment to EC parameter			
if economy is in recession	-0.4408	0.0896	0.0000
<u>Long run components</u>			
LY	0.9846	0.0204	0.0000
LRW	-0.3655	0.0335	0.0000
LHS	0.4298	0.1313	0.0014
TREND	-0.0024	0.0002	0.0000
<u>Short run components</u>			
D(LY)	0.2702	0.0439	0.0000
D(LRW)	-0.0893	0.0416	0.0339
D(LHA)	-0.1798	0.0669	0.0081

The results here, except for the time varying nature of the error correction parameter, are essentially the same as those arrived at earlier. The implied long-run values of the coefficients (the long run elasticities) are: for the elasticity of employment with respect to Production, 0.98 (in the model which made no allowance for asymmetry it was estimated to be 1.06), the elasticity of substitution, 0.37 (it was estimated to be 0.34 in the model which made no allowance for asymmetry) and the elasticity of employment with respect to Standard hours, 0.43 (earlier, it was estimated to be 0.46). The long run coefficient on the time trend (-0.0024) yields an estimated annual rate of technological progress of 1.5% per annum. Comparing these figures with those presented earlier for the model without any allowance for asymmetry the only difference worth remarking on is the lower (and probably more acceptable) estimate for the rate of technological progress (1.5% here compared with 1.9% earlier).⁶⁴ Again, the short run elements have sensible signs and we note that as we have hypothesised there is a negative relationship between actual hours and employment in the short run.

⁶⁴ Our figure for the annual rate of technological progress is arrived at by dividing 0.0024 by 0.63 (ie by $1 - 0.37$) and multiplying the result by 4.

Turning to our estimates for the error correction parameter, we have found that it is time varying in such a way that it is considerably higher (-0.669) when the economy is in recession than when it is not (if the economy is not in recession the error correction parameter is at its ‘base’ value of -0.228). This is a substantial difference which is not only statistically significant but also, in our view, it is of considerable ‘economic’ significance as it helps explain why it is that we see such marked asymmetries in the behaviour of the unemployment rate over the cycle.⁶⁵

Figure 11 shows the cumulative effect upon employment of a 1% increase in non-farm GDP (upper line) and a 1% decrease in non-farm GDP (lower line). The effects of the asymmetry and especially the rapid fall of employment in recession episodes is clearly evident.

[FIGURE 11 NEAR HERE]

IV Concluding Remarks

We have argued that it is important in explaining employment to allow for changes in ‘standard hours of work’ and that, unless actual hours are varying with a change in equilibrium or standard hours, actual hours should not appear (or should not appear with a non-zero coefficient) in the long-run component of an equation for employment. If however standard hours are changing, then it is desirable that this variable be incorporated into the long run component of the employment equation. We derive an expression for the elasticity of employment with respect to standard hours and show that it is related to the size of the premium for overtime. We find empirical support for our approach and are able to provide new estimates of the elasticity of substitution, the scale parameter and the rate of technological change for Australia. We also found marked asymmetry in the speed of the short-run response of employment to variations in real GDP and real wages in recession episodes as against non-recession periods. Our preferred estimates of the long run elasticity of

⁶⁵ Of course asymmetries in the behaviour of participation rates may also play a role (see Dixon (1996)).

employment with respect to the real wage is -0.37 . The error correction parameter is 0.23 in non-recession and 0.65 in recession periods.

Two caveats in particular should be mentioned. First, it is not clear how far into the future one would wish to 'push' this model as increasingly the notion of standard hours as a benchmark between different levels of labour cost is diminishing. Overtime rates are increasingly being absorbed into normal time and thus the distinction between ordinary and overtime hours is featuring in fewer and fewer agreements. Also, time off (at ordinary rates) in lieu of overtime is also a feature of many agreements. Second, we have not dealt explicitly with fixed costs of employment, such as training costs. We have not done so because of data problems in relation to such costs, and especially data problems in obtaining information on how they have varied on a quarterly basis over time. However, a full understanding of employment can only be gained by distinguishing between part time, casual and full time employees, and that of necessity means incorporating fixed costs of employment into the model. Our intention is to attempt to do this in the near future.

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FIGURES

FIGURE 1

Total civilian employment (000's - vertical axis) and Index of Hours worked per employee (horizontal axis): 1965:3 – 2001:3

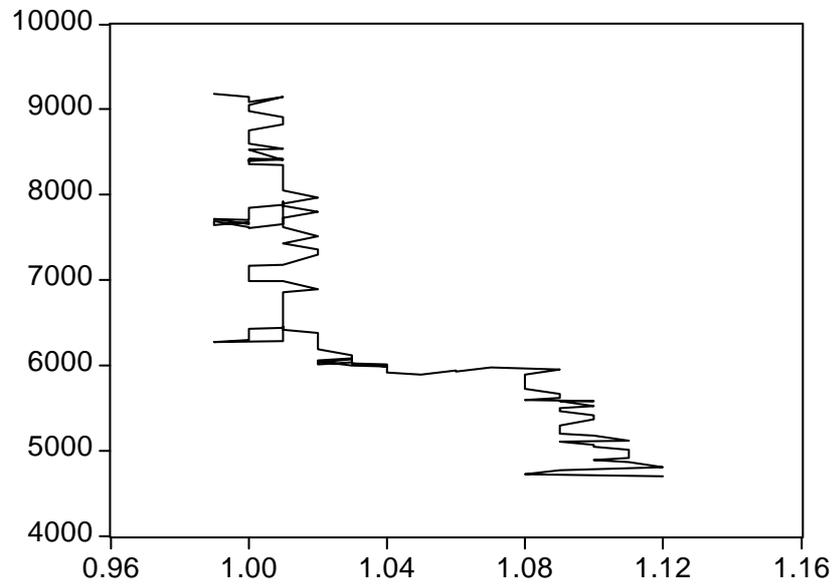


FIGURE 2

Number of non-farm civilian wage and salary earners (000's - vertical axis) and average hours worked per wage and salary earner (horizontal axis): 1965:3 – 2001:3

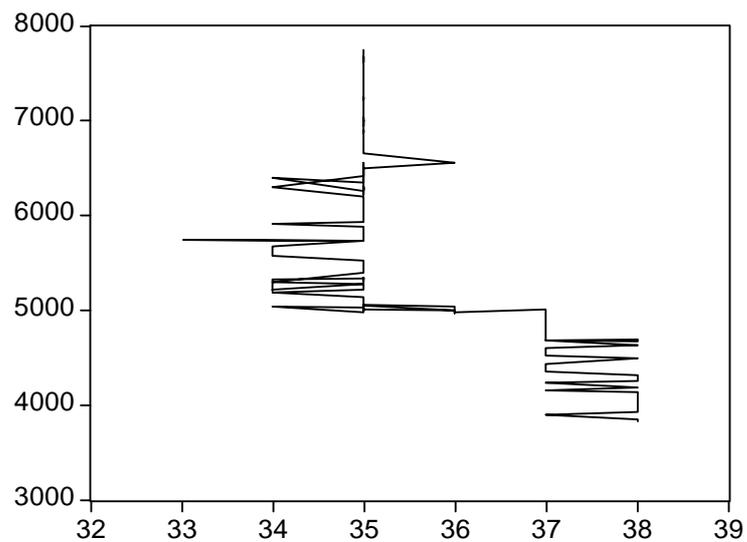


FIGURE 3

Iso-labour services curves. Employment (N) is on the vertical axis and average hours (h) is on the horizontal axis

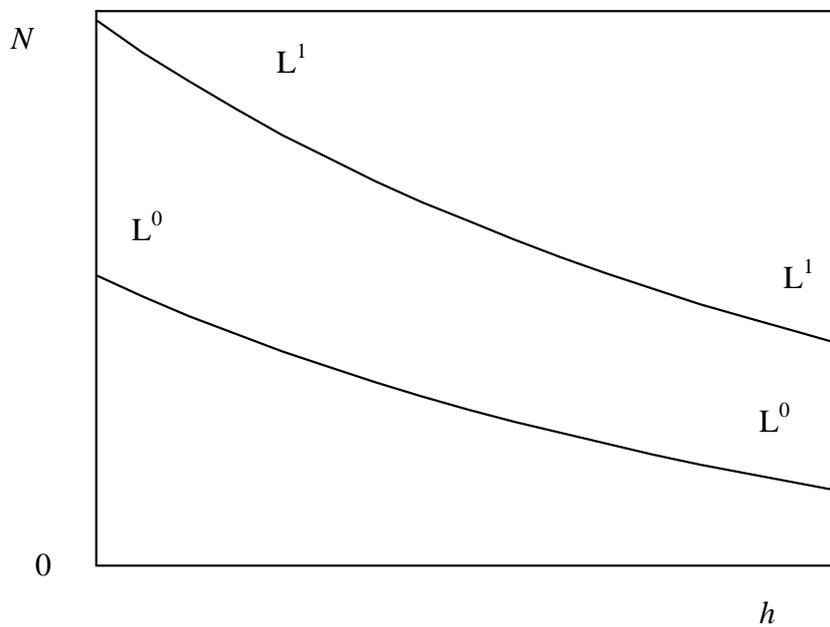


FIGURE 4

Average weekly overtime hours per employee: 1979:3-1999:2



FIGURE 5
An Iso-labour services line (LL - solid line) and an Iso-cost or budget line (CC - broken line)

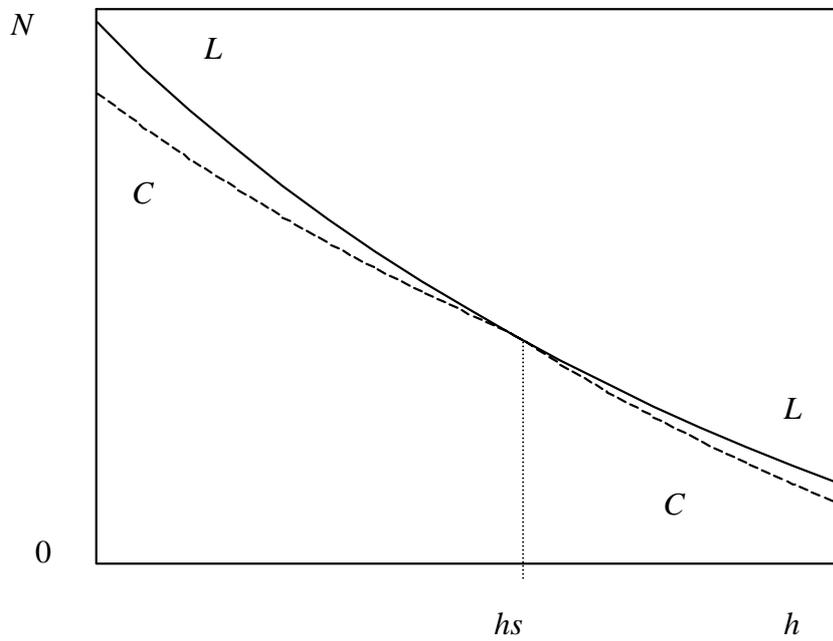


FIGURE 6
The expansion path for employment (solid lines are iso-labour services lines while broken lines are iso-cost lines)

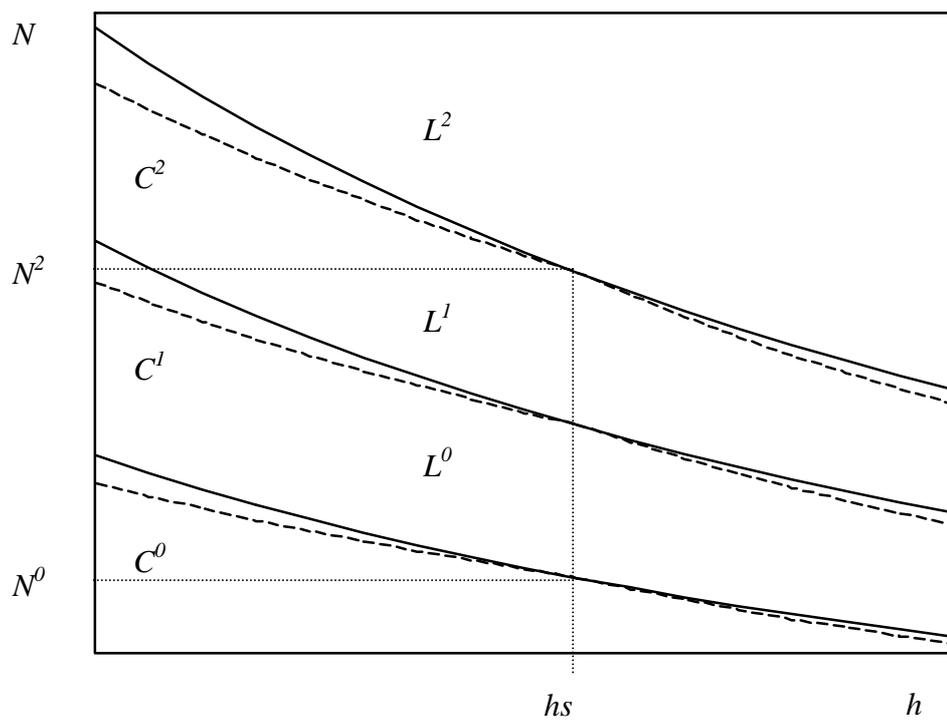


FIGURE 7

The path of employment and hours following a downwards shock to scale (solid lines are iso-labour services lines while broken lines are iso-cost lines)

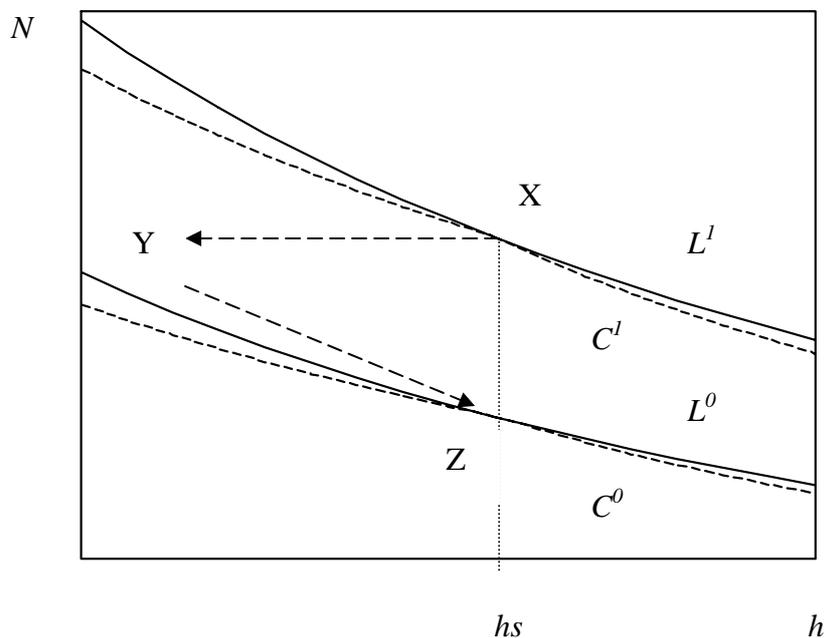


FIGURE 8

Logarithms of real non-farm GDP at market prices (middle line, LH scale), number of non-farm wage and salary earners employed (bottom line, also LH scale) and the real wage (uppermost line, RH scale).

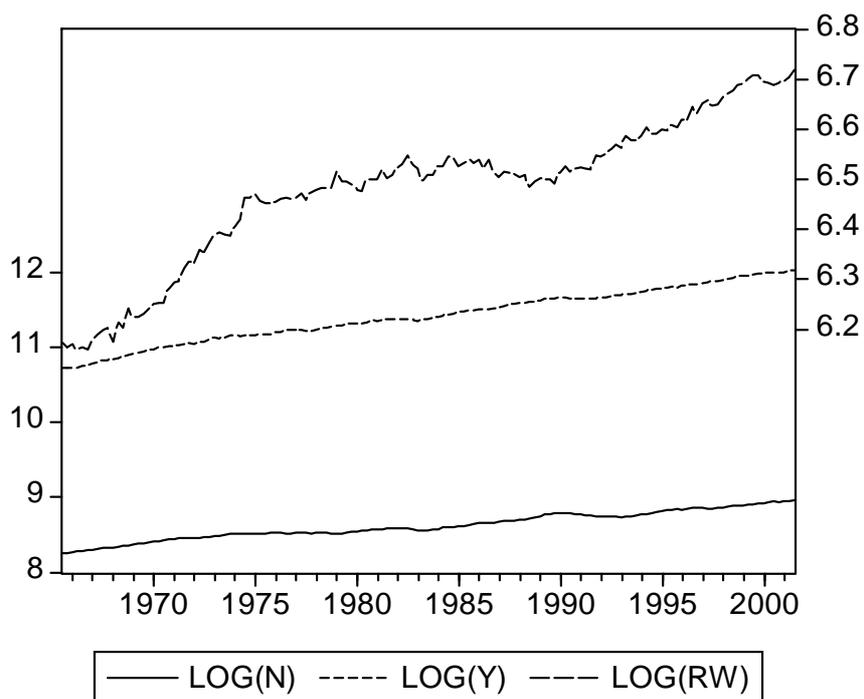


FIGURE 9

Indices of actual (broken line) and standard (solid line) hours of work, both from the TRYM Database in DX

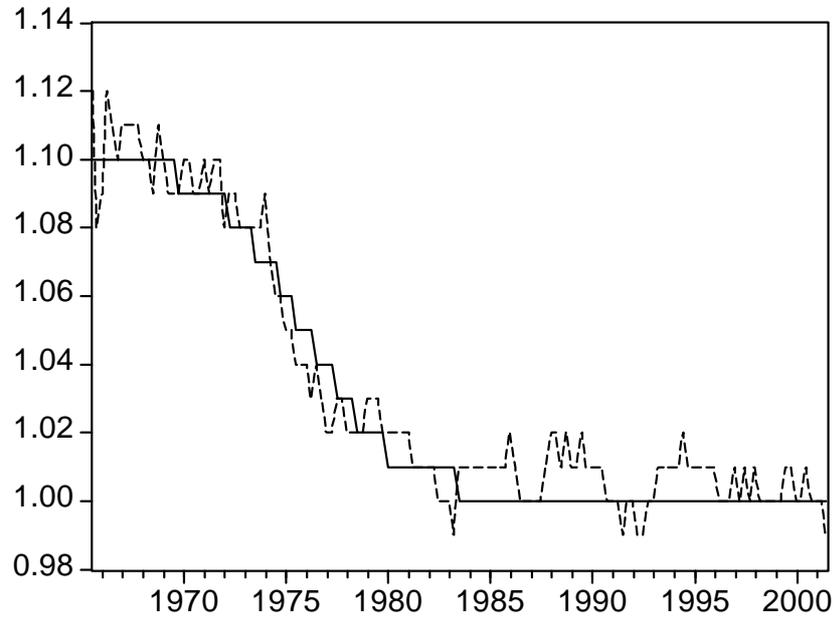


FIGURE 10

Cumulative effect on employment of a 1% increase in real non-farm GDP (top) and a 1% increase in the real wage (bottom line)

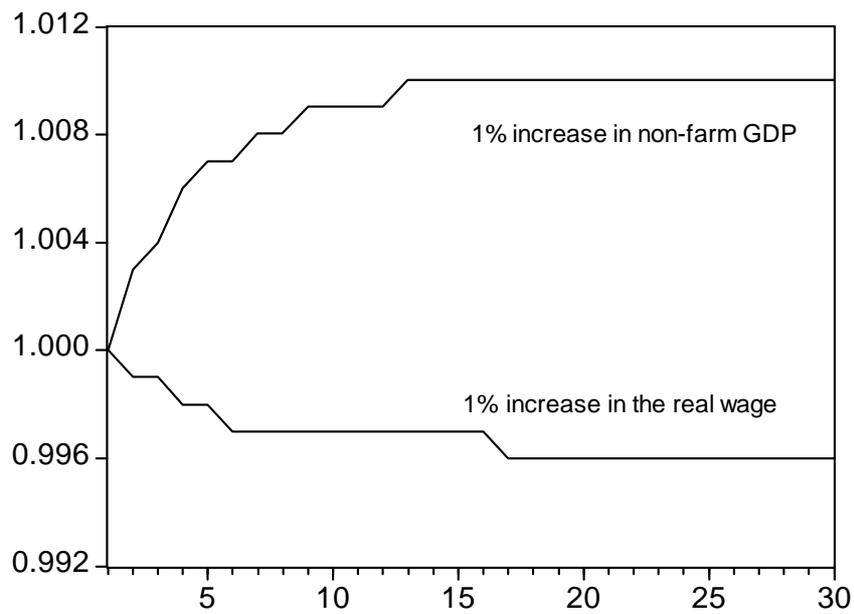


FIGURE 11

*Cumulative Effect on Employment of a 1% increase in real non-farm GDP (top line)
and a 1% decrease in real non-farm GDP (bottom line) allowing for asymmetry*

