Project 22345 CP87826

32nd Annual Conference of the
Australian Agricultural Economics
La Trobe University, Melbourne, 8-12 February 1988

DETERMINANTS OF EMPLOYMENT IN AUSTRALIAN AGRICULTURE

D. Luskin, D. Poulter and M. Nayar

Australian Bureau of
Agricultural and Resource Economics
Canberra

This paper analyses quarterly data on aggregate farm employment. The evidence suggests that family farm employment responds counter-cyclically to changes in farm output prices. This response appears to occur largely among females and may be interpreted as an effort to stabilise family income. The findings offer some limited support for the hypothesis that family farm employment serves as a refuge from unemployment.

The farm labour market has traditionally occupied a marginal place in research on Australian agriculture. This would seem a paradox since labour is the predominant input in farm production. In the ORANI 'typical-year' data base, wages and the imputed cost of family labour account for more than a third of the value of agricultural output (Bruce 1985, p.50). Thus, an understanding of the determinants of farm employment is of paramount importance for analysing the supply of Australian farm products. Moreover, it has considerable relevance to a wide range of policy issues, including those which pertain to farm wages and to programs of farm assistance.

This paper analyses the time-series on farm employment which are collected by the Australian Bureau of Statistics (1986, 1987a). The analysis differs significantly from that of Evans and Lewis (1986), the only other recent study of this type. In terms of theoretical perspective, we attach greater importance to the institutional constraints on wages and to qualitative differences between hired and family farm labour. In addition, in order to elucidate the effects of farm output prices, we have estimated separate employment relationships for each sex.

One of our major objectives in this study is to analyse the relationship between the aggregate unemployment rate and farm employment. In a number of different contexts it has been argued that higher unemployment rates lead to increased levels of self-employment, both in agriculture and other sectors (Stricker and Sheehan 1981; Covick 1982; Burgess 1986). A basic statement of this hypothesis was provided in Norris (1986, p.37):

> 'Put simply if there is an equilibrium allocation between wage and salaried employment and self-employment when full employment rules in the wage and salary sector, this is disturbed when not all those who wish to find work in that sector can do so. Failing to find work in the wage sector, some workers shift into self-employment. Self-employment then acts as a "refuge" from unemployment.'

This statement implies that unemployment involves some rationing of wage and salary employment, but is silent on why this occurs. This omission is significant, since there are many theories of unemployment. In some theories, unemployment is viewed as a search process which generates information on the characteristics of workers and jobs. The need for this type of information is not limited to wage and salary employment, since it is also required for evaluating opportunities in self-employment. Thus, while increases in this 'frictional' unemployment may result from changing technology or other factors, it is not clear that these factors would favour self-employment.

In other discussions of self-employment, the rationing of wage and salary jobs is attributed to downward rigidity in wages. Blau (1987) suggested this as an explanation for the upward trend in self-employment in the United States: 'Increased wage rigidity has increased the proportion of the labour force that resorts to self-employment as a response to being rationed out of wage jobs' (p.448). In Australian labour markets, wage rigidity may result from the operation of the arbitration system or the labour unions. Gruen (1986) has argued that this is a major explanation for persistently high rates of unemployment. Since this argument strikes us as plausible, we view the unemployment rate as a measure of overall wage rigidity. Moreover, since the returns to family farming are not subject to regulation, we predict that increases in the unemployment rate will be

associated with higher levels of family farm employment[1]. (Family employment in this context corresponds to the Australian Bureau of Statistics categories 'employer', 'self-employed', and 'unpaid family helper'.)

In previous studies of farm employment, the existence of unemployment effects has often been assumed rather than tested (Tyrchniewicz and Schuh 1969; Joyce 1975; Smit 1978). Analyses which have taken this approach have used an overall measure of non-farm employment opportunities, the non-farm wage weighted by the ratio of employment to labour force. Crowley and Spasojevic (1980) entered the unemployment rate and the non-farm wage separately and found that the unemployment rate had significantly positive effects on family farm employment. Tauchen (1981) obtained similar evidence in his study of hired farm employment in the United States. Tauchen analysed data for the period 1947-66, which preceded the extension of minimum wage coverage to farm workers. During this period, the market for hired farm labour was largely free of institutional constraints on wages (Tauchen, p.538). This suggests that hired farm employment, like self-employment, served as a safety valve during cyclical downturns. This hypothesis was strongly supported by the study's results, which indicated a significantly negative relationship between hired farm employment and an industrial production index. This, according to the author, confirms 'the well-known fact that aggregate cyclical forces play a strong role in the determination of agricultural labour supply' (p.539).

The analysis in this paper is also concerned with the effects on farm employment of changes in farm output prices. In the long run, one would expect declines in prices for farm output to cause reductions in both hired and family employment. This follows from the assumption that hired and family labour are both 'normal' inputs in farm production. In the short run, however, the input of family labour may exhibit the opposite response. As was noted by Bhati (1978), this possibility may be derived from a model of family decision-making along the lines of Becker (1965). Put simply, a decline in output prices may lead farm families to increase their work effort in order to maintain normal incomes. Part of this response may involve family members shifting from being out of the labour force to on-farm employment. In this case, the adverse effects of a fall in output prices on hired farm employment would be exacerbated.

Evidence of an anecdotal nature is consistent with a short run supply of family labour that is 'backward bending' with respect to farm output prices. Consider, for example, the following [illegible] of how New Zealand farmers are responding to a reduction in government subsidies and import protection.

> 'Hardest hit are the arable farmers on the South Island's Canterbury Plains, whose high-cost cereal grains are no longer protected against imports of cheap Australian grain. But not far behind are dairy and

---

[1] This pertains to the partial effect of a change in the unemployment rate, other things assumed the same. The other determinants of family farm employment include farm and non-farm wages, prices for farm outputs, and the cost of non-labour inputs. The assumption that unemployment can vary when wages remain constant is not inconsistent with attributing unemployment to downward wage rigidity. The extent of wage rigidity depends on the gap between actual and competitive wages rather than on actual wages per se. This gap is widened when actual wages remain constant and aggregate labour demand declines.

> sheep-meat producers in the rich Waikato region of the North Island. There, stories abound of young men running their farm during the day and working after hours at another job, while their wives also work off-farm to earn hard cash, all just to serve interest commitments' (Austin 1987).

This passage suggests that many New Zealand farm families assumed off-farm employment while maintaining their on-farm work effort. However, the same 'income effect' which underlies this particular behaviour may also cause on-farm effort to increase. It is worth noting that the above passage says nothing about the responses of farmers who did not work off-farm. For some farmers, employment of this type may not be a feasible short run option. Opportunities for off-farm employment may be limited by geographical remoteness, locally high unemployment rates or various adjustment costs. In such cases, the only effective outlet for the income effect is an increase in on-farm effort[2].

Additional evidence which is relevant pertains to the output growth on Australian wheat farms between 1985-86 and 1986-87. The evidence from Bowen and Poulter (1987) suggests that output growth had been more rapid for wheat specialists than on other wheat-growing properties. During this period, the prices of beef and wool rose moderately, while the price of wheat declined 9 per cent. This led the authors to speculate that 'some farmers may increase their output in the short term in response to financial adversity' (p.296). Since this type of response cannot be attributed to an increase in capital stocks, it can only reflect an increased use of variable inputs or a running down of assets. In the former case, the response is likely to involve an increase in family labour input.

In this paper, we do not estimate a dynamic model which distinguishes short and long run effects. Nevertheless, our methodology permits some limited inferences about the short run response of family employment to changes in output prices. This is achieved by estimating separate equations for male and female employment. Due to the sex differential in labour force participation rates, we would expect any 'added worker' effect to be more pronounced among females. Thus, if the estimated effects of output price increases are negative for family employment as a whole, and particularly so for females, we may interpret these estimates as indicating short run responses[3].

---

[2] It has already been noted that this may entail family members who were previously non-employed assuming on-farm employment. It may also involve an increase in on-farm hours among family members who are employed outside agriculture. If on-farm hours increase to the point where they exceed hours worked in the non-farm sector, this is registered in the Labour Force surveys as a rise in family farm employment. It should also be noted that one of the factors which could produce this response - a locally high unemployment rate - has particular relevance to areas where agriculture is an important employer of hired labour. In these areas, declines in farm output prices will significantly depress the local job market.

[3] In previous studies on this subject, the dynamic specifications have been somewhat ad hoc, the most common being the partial adjustment scheme (Crowley and Spasojevic 1980; Evans and Lewis 1986). It should be noted that this specification does not allow for changes in output prices to have opposing short-run and long-run effects.

In the preceding discussion, we have referred to the findings from other studies only as they pertain to our central hypotheses. For a more comprehensive review of the related literature, the reader is referred to Powell (1985). The remainder of this paper is organised as follows. After describing the trends in the farm labour market, we present our theoretical framework. The econometric model and our empirical results are then followed by our conclusions.

Farm Labour Market Trends 1967-86

In Australia, as in most other OECD economies, farm employment has followed a secular downward trend, declining from 520 000 in 1940 to 416 000 in 1967 (Evans 1985). This trend persisted until the late 1970s, when farm employment began to recover. By 1986, farm employment had risen by 11.5 per cent above its 1978 trough. Nevertheless, it remained 6.7 per cent below its 1967 level (Figure 1).

Recent trends in farm employment by sex have been sharply divergent, with large gains in female employment nearly offsetting the decrease in employment among males (Figures 2 and 3). Between 1967 and 1986, the number of male workers declined by 21.2 per cent, in marked contrast with female employment, up 73.8 per cent. The differential growth rates by sex are also reflected in the female share of the farm workforce, which rose from 15.2 per cent in 1967 to 28.4 per cent in 1986.

Traditionally, the farm workforce has been dominated by family labour and this was accentuated during the period 1967-86, with the family share increasing by 2.5 percentage points. Although both hired and family employment follow the same U-shaped path over this period, the pattern for hired labour is more pronounced.

The upturn in family employment in agriculture during the 1970s is paralleled by trends in family employment in the rest of the economy. However, the trough in non-farm family employment came somewhat earlier (Figure 4). The share of family employment in total non-farm employment fell from 10.8 per cent in 1966 to 9.8 per cent in 1973. Thereafter, it exhibited a sharp upward trend which tapered off in the 1980s. Between 1973 and 1980, growth in family employment accounted for 46 per cent of all non-farm employment growth, so that by 1980 the family share of non-farm employment was 13.1 per cent. It is interesting to note that similar reversals in self-employment trends occurred in the United States, Japan, and several West European countries at roughly the same time (Blau 1987).

In Australia and many other OECD countries, the mid-1970s were also the watershed for unemployment rates. In Australia, the unemployment rate stood at 8.4 per cent in 1985, up 3.5 percentage points from a decade earlier (Figure 5). With the exception of Japan, the major OECD countries experienced similar increases, although the United States unemployment rate has fallen quite substantially since 1983. The simultaneous upturns in unemployment rates and in the proportion of the workforce self-employed is consistent with the hypothesis that the trends in self-employment reflect increased wage rigidity. However, this does not preclude other explanations. Blau (1987) offered the following hypotheses with reference to the self-employment upturn in the United States: 'Changes in technology, such as personal computers, have made small firms more competitive in many industries'; 'Rising marginal tax rates have made self-employment more attractive because of the ease of underreporting income from self-employment compared with wage-salary earnings' (p.448). Similar arguments were

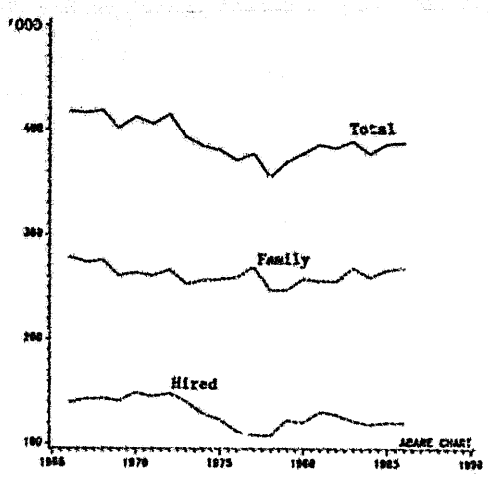


FIGURE 1 - Farm Labour.

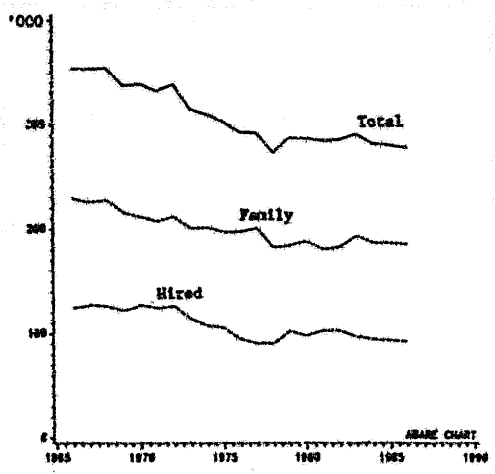


FIGURE 2 - Male Farm Labour.

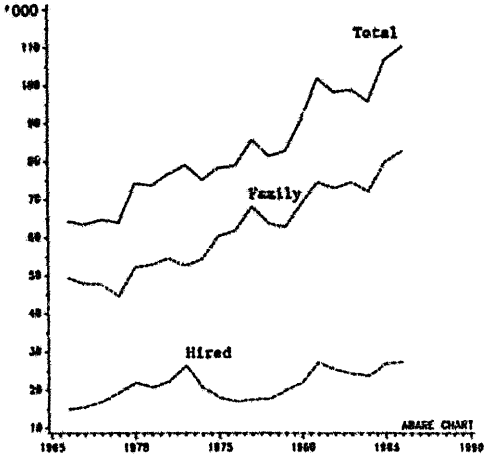


FIGURE 3 - Female Farm Labour.

FIGURE 4 - Family Share of Non-Farm Employment.

FIGURE 5 - Unemployment Rate.

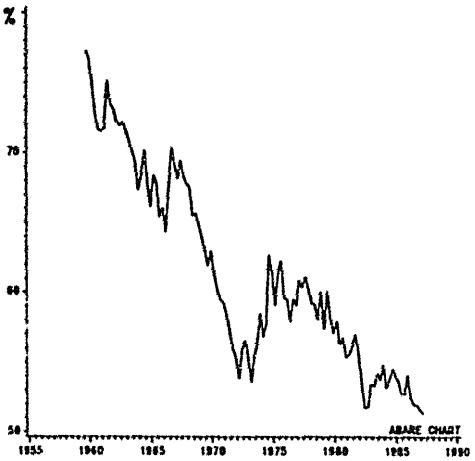


FIGURE 6 - Agricultural Wage Relative to Average Weekly Earnings.

suggested by Covick (1982) in a discussion of the Australian experience. Although we have not attempted to incorporate these considerations in our empirical analysis, they indicate a worthwhile direction for future research on farm employment.

Trends in award wages for farm workers relative to non-farm wages are shown in Figure 6. Overall, there was a substantial downward drift, with the ratio falling by 24 per cent between 1967 and 1986. There was a temporary reversal of this trend during the mid 1970s, when farm award wages increased relative to non-farm wages by nearly 10 per cent. The existence of this break is in one sense fortunate, since it reduces the correlation between movements in farm and non-farm wages. Thus, it permits a more reliable estimation of their separate effects.

Theoretical Framework

This section provides a formal theoretical framework for our empirical analysis. Although it is possible to avoid this step by adopting an 'empiricist' approach, we believe that there are real benefits to attempting theoretical rigour. One such advantage is that it facilitates comparisons with other econometric studies of farm employment. For the most part, other studies have used simple dynamic variants of long run equilibrium models. Hence, in this section, we focus on the nature of long run equilibrium.

In the present context, long run equilibrium refers to the levels of farm wages and employment which eventuate in a stationary environment. Given our objectives, a description of this equilibrium must distinguish between hired and family employment. In order to focus on essentials, the following discussion abstracts from family decision making and considers the behaviour of atomistic individuals. 'Family' workers are in this context synonymous with the self-employed.

In several previous analyses of farm employment, it has been explicitly assumed that hired and family labour are distinct factors of production (Tyrchniewicz and Schuh 1969; Smit 1978; Crowley and Spasojevic 1980; Ellahi 1981). Although this assumption entails some problems, it does capture some aspects of economic reality. A substantial share of family input is provided by farm operators, whose work requires some knowledge of agronomy and other technical or managerial skills. 'Hired labour' may to some extent be equated with tasks for which there is a peak loading problem, such as harvesting or shearing. The skills which are needed for these activities differ somewhat from those involved in farm management. For this reason, we have chosen in this study to view hired and family labour as distinct inputs which are possibly substitutable. This is indicated by the farm production function which is specified in (1). It is assumed that this function exhibits constant returns to scale and that land is substitutable with other factors.

Farm production function

$$(1) \qquad Q = F(L_h, L_f, X, A)$$

where Q = aggregate farm output, L_h and L_f = inputs of hired, family labour, A = input of land, and X = other inputs.

In the discussion which follows it is assumed that institutional constraints on wages are the only source of market 'imperfections'. Deferring only briefly a consideration of these constraints, we first discuss the case of perfect competition. Since the notion of a demand for

family labour is not entirely conventional (Smit 1978, p.35), we start by considering the demand for hired labour.

The function $\tilde{D}_h$ in (2) defines the demand for hired farm labour, conditional on the level of family labour. The profit-maximising behaviour which underlies this demand is described in (3). In (2) and (3), the price of 'other inputs' is the numeraire. Land input appears as an argument in the production and demand functions, although it is assumed to be fixed in supply to the farm sector.

Conditional demand for hired labour

$$(2) \qquad L_h = \tilde{D}_h(w, p, L_f, A)$$

where w = wage rate for hired labour and p = price of farm output.

Profit maximisation problem

(3) Maximise $pF(L_h, L_f, X, A) - w L_h - X$ with respect to L_h and X.

The level of profit which corresponds to the solution to (3), π, is represented by a variable profit function in (4). These profits are gross of the opportunity cost for the individual farmer of holding land. However, given that land is competitively priced, this opportunity cost should equal the marginal contribution of land to profits ($\delta\pi/\delta A$). This permits us to derive (5) as an expression for the net returns per unit of family labour, denoted by v. This may be referred to as an 'implicit wage'.

Variable profit function

$$(4) \qquad \pi = \pi(w, p, L_f, A).$$

Implicit wage for family labour

$$(5) \qquad v = \frac{\pi - (\delta\pi/\delta A)A}{L_f} .$$

Since $\delta\pi/\delta A$ is a function of w, p, L_f and A, the 'implicit wage' can be expressed as a function of these same arguments. This is shown in inverse form in (6).

Demand for family labour

$$(6) \qquad L_f = D_f(w, p, v, A).$$

As the notation suggests, the function D_f can be viewed as a demand function for family labour: it shows the quantity of family labour which would be demanded if family labour were imputed a certain wage and farm profits were max'mised by the 'invisible hand'. The negative own-price elasticity reflects the law of diminishing returns. Other things being the same, an increase in the number of family farm workers will 'crowd the field', leading to a reduction in their implicit wage. It should be noted that the demand function for family labour can be substituted into the conditional demand function for hired labour (2), to obtain the corresponding unconditional demand function (7).

Demand for hired labour

(7) $L_h = D_h(w, p, v, A)$.

In modelling the supply side of the farm labour market, we assume that individuals choose the type of employment which yields them the highest returns. However, individuals are assumed to have differing comparative advantages, resulting in different choices. In order to make the analysis as tranparent as possible, we initially assume a situation in which individuals who have the skills to be family farmers have no aptitude for hired farm work, while potential hired farm workers have the opposite endowments. The consequences of relaxing this assumption are discussed below. Another simplification which we adopt is that within each population of potential farm workers, productivity in farming is assumed to be identical. This assumption is not essential for our analysis and is introduced simply so that the quantities of farm labour inputs (L_f and L_h) can be equated with the corresponding numbers of farm workers (the data available from the Australian Bureau of Statistics Labour Force surveys - ABS 1987a). In this formulation, differences in comparative advantage between farm and non farm employment derive from variation among individuals in their non-farm rather than farm productivity. Thus, within each population of potential farm workers, opportunities for non-farm earnings are assumed to vary.

These assumptions are reflected in the supply equations for family labour (8) and hired farm labour (9). The absence of cross-price effects reflects the assumption of extreme comparative advantage: the supply of labour in each category is uninfluenced by the returns to labour in the other. However, the own-price supply elasticities are positive, since individuals differ in their opportunities for non-farm earnings.
The vector z in each supply function represents the supply shifters, which include measures of employment opportunities in the non-farm sector. The supply shifters of family and hired labour are represented by the same vector, since it would be difficult to identify variables which pertain to only one category.

Supply of family labour

(8) $L_f = S_f(v, z)$.

Supply of hired labour

(9) $L_h = S_h(w, z)$.

These supply equations can be combined with equations (6) and (7) to describe a long run competitive equilibrium. In this equilibrium, the returns per unit of family labour have the characteristic that the level of family employment which generates these returns (demand) equals the number of workers who find their comparative advantage in family farming (supply). Although a number of previous studies have assumed the farm labour market to be perfectly competitive, none of the studies of which we are aware has attempted to estimate the above system of equations. The major obstacle appears to be the problems in measuring v, the returns per unit of family labour. How, for example, does one allocate farm returns between family labour and physical capital on an annual basis? Problems in measurement become even more severe if one uses quarterly time series, owing to the difficulties in measuring farm returns on a quarterly basis. In addition, farm returns can be observed only after the fact, inclusive of the effects

of unexpected events, such as drought. Presumably, the supply of family labour depends on the anticipated returns.

In the light of these considerations, we have decided to eliminate the implicit wage of family labour, v, from our system of equations. If we equate (6) and (8), we can express the equilibrium level of family employment in terms of a semi-reduced form function (10). (This function is 'semi-reduced' because it includes the wage rate for hired labour as an argument.) Similarly, by substituting (10) into (2), we obtain the semi-reduced form function for hired farm employment (11). In the case where hired wages are competitively determined, equations (9) and (11) can be solved for w to complete the description of long run equilibrium.

Semi-reduced form equation: family labour

(10) $L_f = R_f(w, p, z, A)$.

Semi-reduced form equation: hired labour

(11) $L_h = R_h(w, p, z, A)$.

In several previous studies, it has been assumed farm wages are competitively determined. However, this assumption strikes us as rather questionable. As we noted above, the persistently high rates of unemployment in Australia may reflect downward rigidity in aggregate wages, and it cannot be presumed that such rigidity is absent in agriculture. One hypothesis which has been commonly advanced is that downward rigidity is particularly characteristic of low paid occupations, such as farm work. According to this hypothesis, Australia's system of wage arbitration has led to a significant compression of occupational wages, reflecting social concerns with wage justice. Whitfield (1987) has noted that this view is supported by comparisons of wage distributions in Australia and similar countries, but that distributional differences tend to be small[4].

In the present analysis, our view of farm wage determination is relatively neutral. As shown in (12), farm wages are specified to be a function of the supply and demand shifters for hired farm labour and of non-competitive factors, denoted by the vector y. Depending on the values of these arguments, farm wages may be either at or above competitive levels. The only restriction which we impose on this function is that wages are not sub-competitive. The rationale for this restriction is that the system of wage arbitration determines only minimum rates. Thus, if award rates are set below competitive levels, we would expect competitive levels to prevail.

---

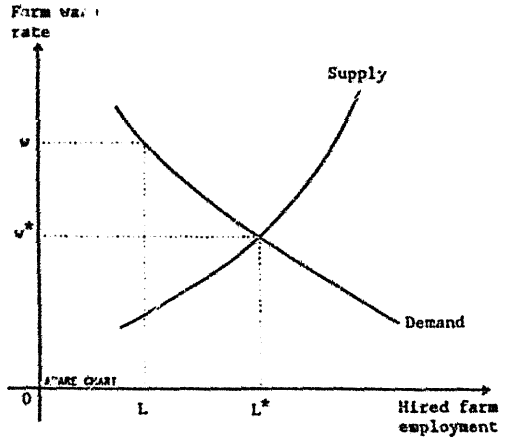
[4] Notwithstanding Whitfield's conclusion, the relative earnings of agricultural workers appear to be substantially higher in Australia than in the United States. This is indicated by estimates of median weekly earnings of full-time employees by occupation. In 1985, earnings in farming, fishing and forestry relative to those in other occupations were 75.0 per cent among Australian males, as compared with 52.6 per cent among males employed in the United States. The corresponding figures for females were 73.7 per cent in Australia and 66.7 per cent in the United States (Australian Bureau of Statistics 1987b; Mellor 1986). These differences may reflect factors other than noncompetitive influences, such as differences in the skill distributions or in the availability of unemployment benefits.

Hired farm wage equation

(12) $w = w(p, z, y)$.

Although this wage equation is not estimated in this paper, it is important for understanding our empirical analysis. The employment equations which we estimate are based on the semi-reduced form equations (10) and (11). It should be noted that estimation of these equations would be inappropriate, assuming perfect competition. In this case, the farm wage, w, is a function solely of the supply and demand shifters for farm labour. Thus, it would not be meaningful to consider the employments effects of a change in the farm wage rate, holding the supply and demand shifters constant. Assuming perfect competition, this ceteris paribus variation in farm wages cannot occur. However, in the case which we consider, this type of variation can result from changes in non-competitive factors. The interpretation of the employment effects of such changes is straightforward and may be verified by referring to the derivation of (10) and (11).

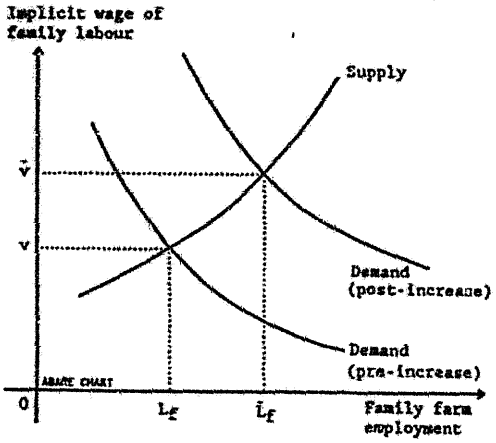
The effects on employment of an increase in the wage above the competitive level are shown in Figures 7 and 8 for hired and family employment, respectively. For hired labour, the effect is unambiguously negative, corresponding to a movement up the demand curve. For family labour, the effect occurs through a shift in the demand curve, owing to increased costs for hired labour. This shift may be either positive (as shown in Figure 8) or negative, depending on whether substitution or scale effects predominate. Thus, the overall effect on family farm employment is ambiguous. It should be noted that in Figure 8 the market for family farm labour remains in a competitive equilibrium after a non-competitive increase in the hired wage rate. This reflects the fact that the implicit wage for family labour is not institutionally constrained. However, the 'new' equilibrium is not identical to that which would prevail if the market for hired labour were competitive as well.



w^*, L^* = competitive equilibrium levels of hired farm wage, employment

w, L = actual levels of hired farm wage, employment

FIGURE 7 - Effects of a Noncompetitive Increase in the Hired Farm Wage Rate on Hired Farm Employment.



v, L_f = competitive equilibrium levels of family implicit wage, employment, prior to noncompetitive increase in the hired farm wage.

$\tilde{v}$, $\tilde{L}_f$ = competitive equilibrium levels of family implicit wage, employment, subsequent to noncompetitive increase in the hired farm wage.

FIGURE 8 - Effects of a Noncompetitive Increase in the Hired Farm Wage Rate on Family Farm Employment.

The preceding analysis alters only slightly if we relax the assumption that individuals are not capable of both hired and family farm work. As indicated in Figure 7, a non-competitive increase in the farm wage rate causes an excess supply of hired farm labour. If, family farming is a relevant option for individuals rationed out of hired farm work, there will be some cross-market 'spill over'. This is an example of the same phenomenon which was described in the introduction, where individuals unable to readily obtain wage and salary employment take refuge in family farming. In terms of Figure 8, this would be represented by a rightward shift in the supply curve. Thus, the semi-reduced form equations (10) and (11) can still provide the basis for our empirical analysis, though care must be taken in interpreting the estimated wage effects.

One problem in estimating relationships such as (10) and (11) is the absence of an appropriate time-series for actual farm wage rates. In previous studies of hired farm employment, it has been generally assumed that workers are paid award wages. However, as was noted above, if award wages are sub-competitive, we would expect competitive wages to prevail. In addition, anecdotal evidence suggests that wages paid to farm workers sometimes fall below award rates due to non-compliance. This is particularly likely when award wages are substantially above competitive levels. It is possible to allow for either of these outcomes by replacing the above wage equation, (12), with equations (13) and (14). The behaviour of the arbitration system in setting award wages is represented in (13) in the same fashion that the determination of actual wage rates had been described in (11) - that is, award wages are made a function of both competitive and non-competitive influences. In (14), the inclusion of supply and demand shifters for hired labour allows for the actual wage outcome to depend on both award and competitive wages, as hypothesised above.

Farm award wage equation

(13) $w_a = w_a(p, z, y)$.

Hired farm wage equation

(14) $w = w(p, z, w_a)$.

If (14) were substituted into (10) and (11), one would obtain alternative equations for hired and family farm employment. In these equations, the unobserved farm wage rate is replaced by its determinants - the award wage and the supply and demand shifters for farm labour. The interpretation of the effects of demand and supply shifters would in this case be less straightforward than in (10) and (11), where it is assumed that the actual wage rate is observed. Since we believe that there is little to be gained from introducing these complications into our analysis, we assume for simplicity that award wages represent the rates actually paid.[5]

Econometric Specifications and Empirical Estimates

The equations which we estimate, (15) and (16), are specifications of the semi-reduced form equations (10) and (11). Land input, A, is not included as a regressor, since it is viewed as fixed in supply. The equations were estimated separately for each sex, using quarterly observations from the third quarter 1966 to the first quarter 1987.

Measures of the market price variables were obtained from components of the ABARE Indexes of Prices Paid and Received: PHL, the award wage index for hired farm labour; PR, the index of prices received for farm products; and PNLI, the price index for non-labour inputs (excluding land). The supply shifters, Z, were represented by average non-farm weekly earnings, AWE, and the relevant sex-specific unemployment rate, UNEM. Time trend was included to capture the effects of trended variables which do not explicitly appear in our equations (such as technological progress).

The price of non-labour inputs appears as a deflator, since we assume homogeneity of degree zero in prices. The choice of deflator is, of course, arbitrary, but it has no bearing on the empirical results.

---

[5] Alternatively, it would suffice to assume that the rates actually paid are proportional to award wages. In order to shed some light on this issue, we have examined the information on weekly earnings from the August supplements to the ABS Labour Force surveys (Australian Bureau of Statistics 1987a). These data are available for years subsequent to 1975 and pertain to earnings of full time employees in their main job. For workers whose main job was in agriculture, forestry and fishing, estimates are published only for males. Due to relatively large sampling errors, caution is needed in comparing estimates from different years. Sampling error should be less of a problem with respect to medium or long term trends. Thus, it is of interest that over the period 1976-86 mean weekly earnings of male workers in agriculture, etc. grew at nearly the same rate as the ABARE index of award wages for farmworkers - 8.7 per cent and 8.8 per cent per annum, respectively. This suggests that the changes in award wages and in wages paid to farmworkers are approximately proportional, at least in terms of long run trends.

$$(15) \quad \log L_f = a_0 + a_1 \log \frac{PHL}{PNLI} + a_2 \log \frac{PR}{PNLI} + a_3 \log \frac{AWE}{PNLI} + a_4 \, UNEM + a_5 t + u_f.$$

$$(16) \quad \log L_h = b_0 + b_1 \log \frac{PHL}{PNLI} + b_2 \log \frac{PR}{PNLI} + b_3 \log \frac{AWE}{PNLI} + b_4 \, UNEM + b_5 t + u_h.$$

The final terms in the above equations denote stochastic disturbances. Given our previously stated assumptions about farm wage determination, these disturbance terms may be correlated with the award wage index, PHL. Previous studies have generally resorted to instrumental variable techniques to correct the resulting bias. In this study, we have not used such techniques for several reasons. First, the advantages of instrumental variable techniques are realised only with sufficiently large samples, whereas the sample in this study is relatively small. Second, an identification problem results unless one can obtain measures of the noncompetitive determinants of wages, and this may not be readily achievable. Third, there may be sources of simultaneity bias in addition to the endogeneity of award wages and attempting to correct for one bias when others are present will not necessarily improve the results[6].

The Ordinary Least Squares (OLS) estimates of equations (15) and (16) are presented in Table 1. The Durbin-Watson statistic clearly revealed autocorrelation in all cases, except in the regression for female family employment, where it was inconclusive. Hence, Table 1 also presents the Generalised Least Squares (GLS) results which were obtained via the Cochrane-Orcutt technique[7].

With respect to the estimated effects of the unemployment rate, the results are somewhat inconclusive. In the case of wage and salary employment the estimates are insignificant for males and significantly negative for females. A possible interpretation of the latter finding is that individuals who find refuge from unemployment in family farming tend to displace hired farmworkers. However, this interpretation would be somewhat strained since the results for family employment provide only limited evidence of positive unemployment effects. The estimated coefficient of the unemployment rate is indeed positive in each of the regressions for family employment, but significantly so only in the OLS results for males. In this latter case, the estimated coefficient is significant at the 10 per cent level.

---

[6] One source of simultaneity bias could be the endogeneity of farm output prices. These are to some extent influenced by seasonal conditions, which also affect the demand for labour.

[7] In comparing the OLS and GLS results it is important to recall that asymptotic advantages are realised only in sufficiently large samples. In addition, there may be interactions between autocorrelation and other statistical problems that we have not attempted to correct. Due to these and other considerations, the OLS results cannot be viewed as necessarily inferior to those obtained from GLS.

TABLE 1

Estimated Coefficients

	OLS		GLS	
	Male	Female	Male	Female
Wage and salary				
log PHL	-1.032	-1.716	-0.734	-1.5016
	(-5.97)	(-5.33)	(-3.04)	(-3.73)
log PNLI	0.587	0.333	0.496	0.307
	(4.27)	(1.66)	(2.48)	(1.07)
log W	0.405	1.036	0.176	0.896
	(2.36)	(3.53)	(0.71)	(2.29)
log PR	0.039	0.347	0.062	0.298
	(0.57)	(3.27)	(0.63)	(2.07)
UNEM	-0.006	-0.04	0.001	-0.037
	(-0.75)	(-2.92)	(0.11)	(-2.17)
Time	-0.004	0.009	-0.003	0.009
	(-3.32)	(4.74)	(-2.51)	(3.60)
Family				
log PHL	-0.175	0.034	0.080	-0.041
	(-1.90)	(0.14)	(0.65)	(-0.14)
log PNLI	0.317	0.148	0.232	0.067
	(4.35)	(1.00)	(1.93)	(0.33)
log W	-0.098	-0.025	-0.286	0.098
	(-1.08)	(-0.11)	(-1.97)	(0.35)
log PR	-0.044	-0.158	-0.034	-0.125
	(-1.22)	(-2.03)	(-0.60)	(-1.21)
UNEM	0.007	0.007	0.005	0.012
	(1.73)	(0.69)	(0.82)	(0.97)
Time	-0.003	0.005	-0.003	0.005
	(-5.20)	(3.86)	(-2.95)	(2.79)

Note: Figures in parentheses are t-statistics. The period of estimation is from 1966(3) to 1987(1). Number of observations is 83. For all variables except log PNLI, the estimates are of the corresponding coefficients in equations (15) and (16). The implied estimates for log PNLI are readily derived from the other results and are presented here for completeness. Note that as implied by our homogeneity constraints, the estimated coefficients of the price variables sum to zero.

TABLE 2

Estimated Coefficients

	OLS		GLS	
	Male	Female	Male	Female
Wage and salary				
log PHL	-1.04	-2.205	-0.741	-1.634
	(-6.05)	(-7.65)	(-3.11)	(-3.91)
log PNLI	0.546	0.382	0.504	0.349
	(4.34)	(1.81)	(2.68)	(1.03)
log AWE	0.439	1.409	0.178	0.959
	(2.66)	(5.09)	(0.73)	(2.21)
log PR	0.055	0.414	0.059	0.326
	(0.84)	(3.82)	(0.63)	(1.99)
Time	-0.004	0.005	-0.004	0.005
	(-5.45)	(3.65)	(-3.26)	(2.57)
Family				
log PHL	-0.165	0.119	0.105	0.078
	(-1.77)	(0.593)	(0.77)	(-0.30)
log PNLI	0.368	0.140	0.239	0.059
	(5.42)	(0.96)	(1.95)	(0.30)
log AWE	-0.140	-0.089	-0.298	0.010
	(- .57)	(-0.47)	(-2.01)	(0.04)
log PR	-0.064	-0.170	-0.045	-0.148
	(-1.82)	(-2.24)	(-0.82)	(-1.49)
Time	-0.002	0.006	-0.002	0.006
	(-5.54)	(6.53)	(-2.97)	(4.85

Note: Figures in parentheses are t-statistics. The period of estimation is from 1966(3) to 1987(1). The number of observations is 83. For all variables except log PNLI, the estimates are of the corresponding coefficients in (15) and (16). The implied estimates for log PNLI are readily derived from the other results and are presented here for completeness. Note that as implied by our homogeneity constraints, the estimated coefficients of the price variables sum to zero.

Due to the lack of significance of most of the estimated unemployment effects, we re-estimated equations (15) and (16) with UNEM deleted. Comparing Tables 1 and 2, it is evident that the results for the remaining variables are broadly similar. Moreover, as before, the hypothesis of zero-order autocorrelation could not be rejected in the results for female family employment.

The most striking results in Table 2 are the estimated effects of increases in output prices on family employment. The evidence suggests short run effects which are negative, particularly for females. The estimates from the OLS regressions imply that a 10 per cent increase in output prices leads to a decline in family employment of approximately 0.6 per cent among males and 1.7 per cent among females. These estimates are significant at the 10 and 5 per cent levels, respectively. The GLS results indicate a similar pattern, although the estimates are not significant at conventional levels. In evaluating these findings there are two points which are worth recalling. First, the coefficients of the output price variable may reflect both short and long run effects. If the long run effects are positive, the short run supply of family labour may be somewhat more backward bending than is indicated by the above estimates. Second, there is no clear evidence of autocorrelation in the results for female family employment, and this lends additional credence to our OLS estimates.

Our interpretation of these findings is reinforced when we consider the results for wage and salary earners. The estimated effect of an increase in output prices is significantly positive for female employment and insignificant for employment of males. These results can be explained in terms of the supply responses of family labour. Presumably, the work of female family labour has more in common with that of female employees than with the work of male employees. Hence, if higher output prices induce a decline in female family employment, any compensating gains in wage and salary employment are most likely to occur among females.

Improved opportunities for non-farm employment, as measured by the average non-farm wage, are estimated to have a significant negative impact on male family employment. The results also indicate that when the award wage for farm workers is held constant, an increase in the non-farm wage significantly reduces hired farm employment. This effect can be attributed to the substitution possibilities between hired and family farm labour.

The other patterns which are revealed in Table 2 are similar to those reported in Evans and Lewis (1986), and may be briefly summarised. Hired farm employment appears to decline substantially in response to increases in award wages. However, there is no evidence that this favours the employment of family workers. The coefficient of the price index for non-labour inputs is significantly positive in the equations for male employment, and this may reflect substitution effects toward labour-intensive production. There is some suggestion of a similar effect among females, but this is limited to wage and salary earners.

The relatively weak evidence of unemployment rate effects which was obtained in this study may reflect several factors. As Evans (1985) has suggested, the availability of unemployment benefits may reduce the need for individuals to turn to family farm employment as a refuge from unemployment. This may also account for the difference between the findings in the present analysis and those in Tauchen's (1981) study of US farm employment. In contrast with Australia, the unemployment benefit system in the United States

States has fairly limited coverage, both in terms of initial eligibility and in benefit duration.

Another relevant consideration is that the equations which we have estimated are nondynamic, whereas changes in the unemployment rate may impinge on the farm labour market via a complex dynamic process. Given that there are certain adjustment costs to entering or leaving family farming, the attractiveness of this activity will be influenced not only by the current unemployment rate but by expectations of unemployment rates over an extended horizon. Thus, Burgess (1986) has argued that self-employment levels depend not so much on current levels of unemployment, as on a perceived 'normal' unemployment rate. Although it would be desirable to incorporate such considerations into an empirical analysis, this is likely to prove extremely difficult in practice. One of the more obvious problems is that the unemployment rate is highly trended (Figure 5). Hence, a 'normal' unemployment rate measured by an adaptive expectations scheme is likely to be highly collinear with time trend.

Conclusions

The major hypotheses which were examined in this paper pertained to the determinants of family farm employment. The hypothesis of positive effects arising from increases in the unemployment rate was motivated by evidence on secular trends. The upturns in both farm and non-farm family employment in the 1970s coincided with an apparent structural shift toward higher unemployment rates. Similar trends are evident in a number of other OECD countries with respect to non-farm self-employment and unemployment rates. In our empirical analysis, we obtained a partial correlation between the unemployment rate and family farm employment, attempting to hold constant the influence of other factors. Although there is a weak suggestion of a positive correlation with respect to male employment, similar evidence is lacking with respect to females.

The evidence in this study is more favourable to our hypothesis of a backward bending supply of family labour. Declines in farm output prices are associated with short run increases in the number of female family workers. The evidence also suggests that there may be a similar effect among males, but it appears to be considerably smaller.

The preceding hypotheses have considerable relevance to the analysis of farm supply response. In a number of models of farm supply relationships, it has been assumed that family labour input, like physical capital, is quasi-fixed in the short run (Vincent, Dixon and Powell 1980; Shumway 1983). The implicit rationale is that significant short run responses to price changes are precluded by adjustment costs. Although this consideration may have some relevance to the principal farm operator, it abstracts from the possibility of a flexible reserve workforce of family members. In addition, it overlooks the possibility of short run fluctuations in on-farm hours worked per family worker. The results in this paper, while pertaining only to the 'added worker' effect, underscore the need to consider hours per worker as well.

In other models of farm production, labour input has been treated as freely variable and its cost has been imputed at some measure of market wages (McKay, Lawrence and Vlastuin 1983; Higgs 1986). The argument which has been advanced in this paper is that the opportunity cost of family labour depends not only on market wage levels, but on the availability of wage employment. A clearer assessment of this argument would possibly result from analysing less aggregated data. A comparison of the data from various censuses reveals

rather divergent employment trends among farm subindustries. For example, between 1971 and 1976, male employment increased considerably in the broadacre sector, while substantially declining in other sectors such as fruit and dairy (Bureau of Agricultural Economics 1983). Thus, the determinants of farm employment might be further elucidated by analysing data for individual farm industries. Perhaps the most suitable source of such data would be the ABARE farm surveys (Bureau of Agricultural Economics 1987).

References

ABS (Australian Bureau of Statistics) (1986), The Labour Force, Australia, Historical Summary, 1966 to 1984, Cat.No.6294, Canberra.

___ (1987a), The Labour Force, Cat.No. 6203.0, February (and previous quarterly issues), Canberra.

___ (1987b), Weekly Earnings of Employees (Distribution) Australia, Cat. No. 6310.0, August 1986, Canberra (and previous issues).

Austin, P. (1987), 'Winds of change across the Tasman', The Land, 16 July, p.1.

Becker, G.S. (1965), 'A theory of the allocation of time', Economic Journal 75, 493-517.

Bhati, U.N. (1978), 'An Analysis of Aggregate Labour Demand and Supply Relationship for Australian Agriculture', Quarterly Review of Agricultural Economics 31(2-3), 106-23.

___ (1980), 'The demand for hired labour on Australian sheep farms', Review of Marketing and Agricultural Economics 48, 71-83.

Blau, D.M. (1987), 'A time-series analysis of self-employment in the United States', Journal of Political Economy 95(3), 446-67.

Bowen, B. and Poulter D. (1987), 'Farm adjustment in a changing grain market', Quarterly Review of the Rural Economy 9(3), 291-8.

Bruce, I. (1985), The ORANI 78 Input-Output and Parameter Files for 1977-78, Impact Centre, University of Melbourne, Preliminary Working Paper OP-51.

Bureau of Agricultural Economics (1983), Rural Industry in Australia, AGPS, Canberra.

___ (1987), Farm Surveys Report, AGPS, Canberra (and previous issues).

Burgess, J. (1986), An Evaluation of Recent Self-Employment Growth, Mitchell College of Advanced Education, School of Business and Public Administration Research Paper 51.

Covick, O.E. (1982), Self-employment growth in Australia, mimeo. Finders University, Adelaide.

Crowley, P. and Spasojevic, J. (1980), 'Econometric analysis of the Australian agricultural labour market: a critique', Bureau of Agricultural Economics paper presented at the 24th Annual Conference of the Australian Agricultural Economics Society, Adelaide, 12-14 February.

Ellahi, M. (1981), The demand for labour and factor relationships in New South Wales. Master's thesis, University of New England, Armidale, NSW.

Evans, S. (1985), 'Recent changes in rural employment', The Australian Bulletin of Labour 12, 57-72.

___ and Lewis, P. (1986), 'Demand and supply, and adjustment of farm labour in Australia', Australian Economic Papers 25(47), 236-46.

Gruen, F.H. (1986), 'How bad is Australia's economic performance and why', Economic Record 62, 180-93.

Higgs, F.J. (1986), Adaption and Survival in Australian Agriculture, Oxford University Press, Melbourne.

Joyce, M. (1975), 'The demand and supply of agricultural labour in Australia', Industries Assistance Commission paper presented at the 19th Annual Conference of the Australian Agricultural Economics Society, Melbourne, 12-14 February.

McKay, L., Lawrence, D. and Vlastuin, C. (1983), 'Profit, output supply and input demand functions for multiproduct firms: the case of Australian agriculture', International Economic Review 24(2), 323-39.

Mellor, E. (1986), 'Weekly earnings in 1985: a look at more than 200 occupations', Monthly Labour Review, Washington, Government Printing Office, September, 28-32.

Norris, K. (1986), 'Self-employment in Australia', in W.J. Merrilees (ed.), Professional Incomes, AGPS, Canberra.

Powell, R. (1985), 'Employment patterns in rural regions', in R. Powell (ed.), Rural Labour Markets in Australia, AGPS, Canberra.

Shumway, C.R. (1983), 'Texas crops as a multiproduct industry, American Journal of Agricultural Economics 65(4), 748-60.

Smit, B.E. (1978), 'Employment of family and non-family labour in agriculture', Canadian Journal of Agricultural Economics 26(1), 35-42.

Stricker, P. and Sheehan, P. (1981), Hidden Unemployment: The Australian Experience', University of Melbourne.

Tauchen, G. (1981), 'Some evidence on cross-sector effects of the minimum wage', Journal of Political Economy 89(3), 529-47.

Tyrchniewicz, E.W. and Schuh, G.E. (1969), 'Econometric analysis of the agricultural labour market', American Journal of Agricultural Economics 51, 770-87.

Vincent, D.P., Dixon, P.B. and Powell, A.A. (1980), 'The estimation of supply response in Australian agriculture: the CRESH/CRETH production system', International Economic Review 21(1), 221-42.

Whitfied, K. (1987), The Australian Labour Market, Harper and Row, Artamon NSW.