New Technology and Jobs:
Comparative Evidence from a Two Country Study

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1. INTRODUCTION

It is widely recognized that one of the greatest economic problems facing developed countries is unemployment. An example of this recognition is the recent report by the OECD ("The OECD Jobs Study", 1994) on unemployment, its causes and possible policies. One issue that is closely associated with unemployment in many people's minds is competitiveness, and associated with that is the use of new technology. Indeed, the OECD Jobs Study plots out the relative importance of 'high-tech' manufacturing in each member country. This paper aims to contribute to the debate on this issue by examining the impact of the introduction of new technology on employment growth and profitability. We use two complementary datasets: two large representative cross-sections of establishments in Britain in 1990 and Australia in 1989/90. We investigate the effect of innovation in each country and then compare the outcomes.

In general, international comparative studies using establishment data are afflicted by many problems. These include different definitions (for example of an establishment, of employment), different sampling frames and differences in methodology and purpose (see Blanchflower, 1994). These problems are much reduced in our dataset, because the questionnaire used in both countries is very similar, the methodology is similar; indeed the Australian survey was largely based on the British one.

The empirical literature on micro-level employment change has taken off in recent years with the increasing availability of large plant/establishment or firm level datasets. Leonard (1987) was one of the first papers followed by Dunne, Roberts and Samuelson (1989) in the United States. The subject has been given a high profile by the work of Davis and Haltiwanger (1990, 1992) and Davis, Haltiwanger and Schuh (1996). The main themes of this work include emphasizing the sheer heterogeneity of employment growth rates and implied dominance of the firm-specific idiosyncratic effect. There has also been considerable interest in the correlates of high job reallocation including the size, age and industry of the firm and the state of the aggregate economy. In Great Britain Blanchflower and Oswald (1990) and Blanchflower, Millward and Oswald (1991) examined employment growth at the level of the establishment, and Blanchflower and Burgess

(1996) investigated job creation and destruction. OECD (1994) summarizes the available international evidence. This outpouring of evidence has stimulated a number of theories attempting to explain the empirical evidence, particularly the time series correlation with the business cycle. Some of these theories can be interpreted as making the introduction of new capital the trigger for the reallocation of jobs (Davis and Haltiwanger (1990), Caballero and Hammour (1994) and Mortensen and Pissarides (1994)). This role for new technology has not been empirically investigated to our knowledge, and this paper offers some evidence on this.

The main questions we address are the following: first, is the introduction of new technology associated with higher or lower employment growth rates, holding all else constant? Second, what other factors appear to be associated with the success of new technology? Third, is the introduction of new technology more likely to be associated with better employment growth in a UK-style regulatory regime or an Australian-style regulatory regime? Finally, is there any difference in the relationship between introduction of technology and employment growth as the intensity of product market competition varies?

The rest of the paper runs as follows: in section 2, we discuss the data; in section 3, we provide a framework for modeling; the results appear in section 4 and section 5 offers some conclusions.

2. DATA

In this paper we use two large scale representative cross-sections of establishments, one for the Britain taken in 1990, and one for Australia taken in 1989. These are the Workplace Industrial Relations Survey (WIRS) and Australian Workplace Industrial Relations Survey (AWIRS) respectively. Both of these cover public and private sectors and almost all industries[1]. The sample design and methodology are very similar between the two surveys and the questionnaires contain a great overlap of questions.

[1] Excluded industries in Australia are agriculture, forestry, fishing and hunting and defence; in the UK: agriculture, forestry and fishing, coalmining and the Armed Forces.

To date, there have been three nationally representative surveys of industrial relations issues in British workplaces with at least 25 employees which were conducted in 1980, 1984 and 1990 (more details are in Millward et al., 1992). The surveys have been used quite extensively by industrial relations researchers and by labour economists to analyze a range of issues (see Millward, 1992, for a description of this research). They are very rich in terms of information on industrial relations issues, but also contain various questions of interest to economists. The 1990 survey that we use here (WIRS3) contains information on 2061 workplaces.

The Australian Workplace Industrial Relations Survey (AWIRS) contains data on 2004 workplaces with at least 20 employees. It is described in some detail in Callus et al. (1992). The differences in sampling arrangements between WIRS3 and AWIRS concern the size cut-off (25 versus 20 employees) and that WIRS3 excludes mining establishments. We use comparable samples by excluding Australian mining workplaces and those with less than 25 workers (in fact only 6% of the sample had employment between 20 and 24). Some of the questions asked in AWIRS are directly comparable with those from the British surveys, though there are, in some cases, different wordings and different questions asked. Our work attempts to ensure comparability of both questions and samples used in our empirical work below. Fuller details on sampling frames and the overall nature of both surveys are given in the Data Appendix.

The unit of observation is an establishment, and the surveys include establishments with at least 25 employees both at the time of interview and at the time the sample was drawn. Thus there are no deaths in the sample and no real births[2]. In both surveys, several interviews were taken, typically with a general or personnel manager, a financial manager, and a worker representative. We use data from the general and personnel managers interviews here.

Before turning to the particular questions we utilize in the analysis, there is a final issue to address. There have been 3 WIRS surveys in Britain, 1980, 1984 and 1990, and we must consider carefully which is the most appropriate to compare to the 1989 AWIRS. Choosing the nearest

[2] For some observations, employment at time (t-1) is recorded as zero or missing; but this cannot be a real birth as the establishment had to be alive previously to be included in the sampling frame.

calendar date is not necessarily the best option, since there are a number of features of the environment in which the survey is taken that need to be matched. The major feature to match is the state of the labour market, particularly the state of demand. Data for the two countries on unemployment rates are shown in Figure 1. In 1990 in the UK, the economy was about at the peak of the boom, whereas in 1984 unemployment was very high (though flat), and 1980 saw the start of the rapid rise in unemployment. In 1989 in Australia, the economy was booming, with unemployment at 5.7%. A comparison of these suggests that the 1990 WIRS in Britain does in fact seem the most appropriate choice.

The main variables of interest that we use are employment, the introduction of new equipment, the presence of unions, and product market structure. We discuss these in turn. The definition of employment is fairly straightforward: we simply use the total number of people employed at the site, full-time plus part-time, manual plus non-manual, and including casual workers. To calculate employment growth rates, we adopt the convention used by Davis and Haltiwanger (1990), namely to divide the annual change in employment at the workplace by the *average* of current and last year's employment (we also check our results by using the conventional growth rate definition, and the first difference in the log of employment).

The key variable in this study is the introduction of new technology and equipment. Both surveys have sections on the "Introduction of Change", who it principally affected, and who took the decision to introduce it. Here we are concerned more with the effects of its introduction. The main questions we use are:

Australia: "Which, if any, of these have affected this workplace in the last two years?"....."Introduction of major new plant, equipment or office technology" *{General Manager}*

Britain: "During the past three years {OR since you have been operating here} have there been any of the following types of change, directly affecting the jobs or working practices of any sections of the **manual** workforce?" ....."The introduction of new

> plant , machinery or equipment (excluding routine replacement)" *{General Manager}*
>
> "During the past three years {OR since you have been operating here} have there been any of the following types of change, directly affecting the jobs or working practices of any sections of the **non-manual** workforce?" ....."The introduction of new plant , machinery or equipment (excluding routine replacement)" *{General Manager}*

In Australia, this question was asked of all establishments, but in Britain there was a slightly more complex approach. The question regarding manual workers was asked only in establishments with 25 or more *manual* workers, and similarly the question regarding non-manual workers was asked only in establishments with 25 or more *non-manual* workers. So some establishments have two variables, some have just a manual technology introduction variable, some have just a non-manual technology introduction variable and some have neither. For comparison with the AWIRS data, we took our new equipment introduction variable to be positive if there was introduction of new equipment affecting *either* manual *or* non-manual workers[3]. Note that in both countries, this is process technology, not product technology. We also present results separately depending upon whether the change affected manuals or non-manuals.

In the British WIRS, there are supplementary questions regarding the nature of the new technology: for manual workers, "Did the introduction of new plant, machinery and equipment include microelectronics technology - i.e.. microprocessors or integrated electronic devices?", and for non-manual workers, "Did the introduction of new machinery and equipment include word processing equipment, computing facilities, other microelectronic technology?"[4]. In fact, *all* of the

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[3] In the econometric work when we examine these questions we restrict the sample in turn to those workplaces with at least 25 manual workers and 25 non-manual workers. We also ran the equations on the full sample but included dummies to capture the role (if any) of small numbers of manual and nonmanual workers. The variables were always insignificant and the results were essentially identical to those obtained using the former method.

[4] There are also many questions about the types of computer facilities, microelectronic equipment and automated machinery in use at the plant in WIRS. However, while producing some interesting cross-tabulations, this data is not very helpful since we do not know when it was acquired.

new equipment for non-manuals involved at least one of the types of technology listed above. For manuals, about half of the new installations involved microelectronics, though in establishments bigger with at least 100 people, around two thirds did. So we feel it reasonable to refer to this data as capturing the introduction of new technology. We make use of both of these sets of responses.

There is an obvious problem in the difference in timing between the two surveys, the new equipment being introduced up to 2 years ago in AWIRS and up to 3 years ago in WIRS. This matters for comparisons within each country and particularly between countries. On average, and holding all else constant, the time since introduction will be somewhat longer in Britain than in Australia. This will not be true if the pace of innovation is so fast that neither the 2 or 3 year cut-offs bite. In the case of the British data we have details of employment in 1990 and in 1987 and hence are able to estimate employment change equations over a three year period. In the Australian data we are only able to estimate a one year change.

Both surveys ask detailed questions about the presence, strength and activities of unions. Here we include variables recording whether there are any unions at the workplace. In two earlier papers using data from the 1980 and 1984 WIRS surveys unions were found to have a negative effect on employment (Blanchflower and Oswald, 1990 and Blanchflower, Millward and Oswald, 1991 respectively). This result has been confirmed in a series of other papers including Leonard (1992) for the US, Long (1993) for Canada and more recently Rama (1995) for Jamaica.

One of the most interesting features of these datasets is the detailed inquiries on the nature of the product market that the establishment operates in. There are a number of questions including whether the establishment's market is chiefly local, regional, national or global, about the nature of entry barriers, about the elasticity of product demand, whether the establishment faces no, few or many competitors, and a measure of the intensity of competition facing the establishment. Answers to these questions appear to be largely coherent in the sense that they correlate in the expected ways. We generally use the reported degree of competition, as this might be thought to summarize the other information. For a recent analysis of the effects of product market competition on wages

and productivity in Britain and Australia using these two datasets see Blanchflower and Machin (1995).

To summarize: our data have particular strengths and weaknesses. The main weakness is that we have no longitudinal element, so our results will be vulnerable to a fixed effects/omitted variables critique; this also highlights the simultaneity problem discussed below. A second weakness is that we do not know much about the type of new equipment introduced. These points are countered by the main strengths of our data. First, we have good data on profitability of establishments so we can evaluate two important outcomes of the process - employment growth in particular. Second, we have the data on the nature of product markets, which clearly must be crucial to any analysis of the introduction of new technology. Third, we have essentially the same questionnaire on two different countries allowing a much more plausible international comparison than is usually possible.

One of the main features of interest in this study is this ability to compare results from two different economies with different regulatory regimes in labour and product markets. To facilitate this, we finally briefly describe these features for the British and Australian economies.

Traditionally, Australia has been a protected and regulated market. High tariff barriers have been an integral part of economic policy and product markets have seen a high level of government presence. However, by the end of the 1980s, this was changing and quite substantial and sustained reforms were underway to reduce tariffs, to increase competition, liberalize financial markets and generally to remove government controls ("corporatisation"). By the time of our survey, 1989, this process had been continuing for some time but still had some way to go. The OECD Annual Report on Australia in 1990 (referring to 89/90) notes that "Market structures are not noticeably conducive to competition in Australia" (p. 49). Labour markets are also relatively highly regulated. From 1983, the Accord between unions and government acted through centralized wage bargaining to keep real wages low and reduce strike activity.

The UK had also experienced a great deal of deregulation and pro-competitive policy. However, much of this was already in place by 1990, and it seems fair to characterize product

markets in Britain as being generally more open and competitive than Australian ones. Labour markets also are less centralized, and unions are probably weaker in Britain. Differences in labour turnover are negligible, however.

Overall, it seems reasonable to argue that product markets in Britain in 1990 were generally more competitive than corresponding ones in Australia in 1989, and labour markets were more decentralized and deregulated.

3. MODELING ISSUES

This section is not going to provide a full structural model for the issue we are analyzing. Rather, we aim to set out the framework in which our results can be interpreted and sketch out what such a model might look like.

What we will observe in the data is the equilibrium relationship between technology adoption and employment or points on the adjustment path to that equilibrium. We think of the process as having two components. First, the decision by the individual plant on whether/when to introduce some new equipment, and second, the equilibration process in the market as other firms react and new entry may take place.

The first of these is essentially an investment decision. One set of problems studied in the industrial organization literature is the optimization of R&D expenditure, issues in patent races, efficient R&D organization etc.. This is not the issue here: we simply have the question of a plant introducing some new equipment. The basic idea is simply that firms are forward-looking profit-maximizing organizations, which will take decisions on the basis of expected present value maximization. Consequently, new technology will be introduced when it is thought profitable to do so. There may be financing constraints complicating the matter. The impact on employment is less clear cut. If the technology is labour-saving, one would expect the same output to be produced with fewer workers. But as it is also cost-reducing, the firm can expect a bigger market share, more output and hence more employment. Thus the size of the output effect on employment appears to be crucial.

The second aspect of the process is the equilibration of the product market. Here is the importance of the structure of the product (and labour) markets that the firm operates in. Suppose we think of competitive markets as those in which entry is relatively easy and in which a small fall in unit costs would generate a substantial increase in output (and hence employment). If competition is lower, falls in unit cost have less effect on output and entry is harder. How will this classification affect the relationship between the introduction of new equipment and employment? For a given cost reduction (and initial employment loss), the output effect will be greater in a competitive industry than in a less competitive industry. Hence we would expect to find new technology having bigger employment effects in more competitive industries. One issue that we cannot control for directly is the 'amount' of new equipment introduced: it may be that bigger effects in some cases simply reflect a bigger initial investment; all we can do here is to use the establishment's size and whether it is a single independent establishment as controls for financial resources and the amount spent on new equipment.

A further complicating feature prevalent in both economies is the presence of trade unions. Unions bargain for higher wages for their members and attempt to protect their jobs. The effect of unions on profits, investment, productivity and employment have all been studied (for a summary see Metcalf, 1994). There is also some analysis of the role unions play in influencing the timing of R&D innovations. There is obviously a connection between unions and product market structure in that unions are more likely to thrive where significant rents can be extracted. Here we allow unions to affect the impact of technology on employment.

There are well known issues of simultaneity in the decision to implement some new equipment, and given that we have a single cross-section for each country, we cannot rule out the effects of unobserved heterogeneity. One problem cited is that an unobserved demand shock hitting the firm may simultaneously cause the firm to change employment and introduce new technology. In fact, we can partly deal with this problem since both questionnaires ask whether demand for the establishments output is rising, stable or falling; therefore we can condition on demand shocks. Another problem is simply that for unobserved reasons some firms are generally going to be

growing and introducing new technology, and this correlation clouds the estimation. Other than including as many controls as possible, we can do very little about this. However, unless the unobserved heterogeneity differs in particular ways between product markets and between countries, we should still be able to say something useful about *differences* in the relationship between technology introduction and the outcome across these boundaries.

4. RESULTS

As a general background, we start by showing that the size, age and industry distribution of employment in the two countries is very similar. The unit of analysis in what follows is the establishment. Comparing the weighted data in Appendix Table 1, we see that there are slightly more small establishments in the UK, and slightly fewer old establishments, but few major differences[5]. A higher proportion of the workplaces in the Australian were at least 20 years old than was found to be the case for Great Britain (59% and 49% respectively). The proportions in manufacturing were identical.

Appendix Table 2 provides some summary measures of the employment growth distribution in Britain (1990) and Australia (1989). The top line simply confirms that employment was growing more quickly in Australia than it was in Great Britain. This occurred because of a higher job creation rate and a lower job destruction rate[6]. The job reallocation rate is the sum of these two rates and is a measure of the intensity of reallocation in the economy. It should be corrected for the growth of total employment, and the final line does this. XS (excess) job reallocation is total job reallocation minus that required to accomplish net employment growth, so for Australia 9.99=11.17-1.18. These numbers are very similar between the two economies, though

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[5] The sample weights are imposed to ensure the results are statistically representative. Both the AWIRS and WIRS3 over-sampled large workplaces. For further details see the data appendix.

[6] The job creation rate (JC) is the average employment growth rate among establishments that are growing, while the job destruction rate is the absolute average employment growth rate among establishments where employment is falling (JD) -- see Davis and Haltiwanger (1990). In both cases the denominator is the average of the current and lagged employment values. For an analysis of JC & JD in Great Britain see Blanchflower and Burgess (1996).

suggesting that job reallocation is slightly faster in Britain. In this paper we are concerned with the employment growth rate rather than job reallocation.

The questions we address are the following:

[a] Is the introduction of new technology associated with higher or lower employment growth rates, holding all else constant?

[b] What other factors appear to be associated with the success of new technology?

[c] Is the introduction of new technology more likely to be associated with positive employment growth in a UK-style regulatory regime or an Australian-style regulatory regime?

[d] Does a change in working practices or work organization have the same effect on employment growth as the introduction of new technology?

[e] Is there any difference in the relationship between introduction of technology and employment growth as the intensity of product market competition varies?

We organize the answers to these questions by first looking at a series of means, then presenting employment regressions for each country, and finally examining and interpreting the differences between the two countries.

Tables 1a and 1b shows the extent to which technology was introduced in Australia and Great Britain respectively. 35% of private sector establishments and 48% of private manufacturing establishments in Australia reported the introduction of some form of new technology over the preceding *two* years compared with 52% and 66% respectively in Britain over the preceding *three* years. As might be expected we find evidence that the introduction of new technology is positively correlated with (lagged) employment size whether one year prior to the date of interview or three years earlier.

Tables 2a presents employment growth rates (defined as a percentage) in Australia according to whether or not new technology had been introduced. As noted above this covers a two year period for Australia. Results are presented separately for the economy as a whole and for the private sector. Here employment growth is defined following Davis and Haltiwanger (1990, 1994) and Davis, Haltiwanger and Schuh (1995) as $(N_t-N_{t-1})/((N_t+N_{t-1})/2)$. It is clear that it is

important how we weight the data. Simply applying the sample weights (to achieve a representative sample), as is done in the first row shows that non-innovating establishments tended to grow faster than the others. However, if we weight the observations by the sample weights and by size (as defined above, the average of current and lagged employment), then we get the opposite result. The reason is this: there appear to be substantial differences between big and small establishments in their reaction to new technology, consistent with the results reported in Table 1a above. It is well known that most workplaces are small, yet most employment is in big workplaces. Weighting additionally by size therefore gives us a view as to what is happening to total employment, whereas not weighting by size reveals what is happening to the average establishment. In our regressions below, we do the latter since we are trying to pick up a behavioral relationship between workplaces. In this table it is useful to present both, since the simple non-size weighted mean is misleading. The reason for the difference between the columns is that there is a relationship between employment size and the introduction of new technology. As we will see below, the innovation varies by establishment size and the impact of innovation on employment growth varies according to the number of workers employed.

Table 3a, which uses the sample weights only, shows that amongst the smallest establishments non-innovating establishments had faster employment growth, but that amongst bigger establishments the reverse is true. Given that it is also true in the Australian sample that big establishments are more likely to introduce new technology (see Table 1a), this helps top explain the employment growth results in Table 2a.

The corresponding data for Great Britain are in Tables 2b and 3b. As noted above this relates to technical change occurring over a three year period so employment change is defined as $(N_t-N_{t-3})/((N_t+N_{t-3})/2)$. Without the size weights, employment growth in Table 2b is higher in establishments that introduced new equipment. When the size weights are used the picture is reversed. Looking at employment growth by base year size in Table 3b, which uses the sample weights, suggests that growth rates tended to be higher in the smallest establishments. However, there is a very jumbled pattern of innovation and employment growth across size bands.

In Table 4a and 4b we report employment growth rates by union status. In the case of Great Britain we break up union establishments into those with both manual and non-manual union members present as well as those with only manual members or only non-manual members. In both countries the growth of employment is higher in non-union workplaces than in union. On average employment growth rates are higher where technology has been introduced. There is some evidence of this in the union sector in WIRS, except in union establishments where only non-manual workers are in unions.

In Table 5a and 5b we report employment growth rates by the degree of competition in the product market. There is evidence from both countries that the higher the degree of competition the higher the growth in employment. It is not clear whether we are simply picking up a size effect or even a union effect in the data or whether there are remaining competition effects once we control for workplace and industry characteristics. As it turns out we find no role for market competition in our employment regressions.

We now turn to estimating a series of employment change equations using the employment growth rate (defined as in Davis-Haltiwanger) as the dependent variable, and using OLS. The variables included are by and large the standard set of controls used in such work, with the exception of the technology variables upon which we focus. The controls include fifty 2-digit industry dummies, five age dummies, three unionization dummies, and a single independent establishment dummy. We also have available the manager's view of whether demand for the product is increasing, decreasing or stable. This is clearly not exogenous, but we are not interested in its coefficient; we hope it will pick up some of the unobserved heterogeneity in the error term that might otherwise have corrupted the coefficient on technology. We also include two dummies ('few' competitors and 'many' competitors) to control for the degree of competition in the product market.

Results for the private sector in Great Britain are given in Table 6 using unweighted data. In column 1 we include the most general specification of the technology variable available to us -- had technology been introduced over the preceding three years for manuals or non-manuals. Two-thirds of the (weighted) establishments reported in the affirmative that they had introduced new

technology over the previous three years (see the final column for the means). The new technology variable enters significantly with a t-statistic of over 3.6 and a positive coefficient. The introduction of new technology is *positively* correlated with job growth. Over a three year period it raises employment growth by 7.5% or approximately 2.5% per annum. Other variables in the regression are largely unremarkable: log N_{t-1} is significantly negative. Older establishments grow more slowly than young ones. The union variables are rather weak (the excluded category is no members present) although the presence of a non-manual union only -- which is a fairly rare event occurring in only about 7% of establishments -- lowers employment. Further experiments with 1 digit industry dummies, other right hand side variables and different dependent variables produced little change.

We also experimented with another variable relating to changes at the workplace over the preceding three years[7]. For both the manual and the non-manual workforce separately, employers were asked the following

> "During the past three years have there been here any of the following types of change, directly affecting the jobs or working practices of the manual(non-manual) workforce.....substantial changes in work organization or working practices not involving new plant, machinery or equipment?

In each of the columns of the Table we include a dummy variable set to one if the establishment had experienced organizational change that affected either the blue-collar or the white-collar workforce. In Table 7 we separate out the effects for the to skill groups. The technology effects we observe do not appear to be proxying separate changes in working practices. Changes in working practices appear to *lower* job growth by up to 3% per annum whilst the introduction of new technology encourage job growth.

In column 2 of the table we added two dummy variables to proxy the degree of competition in the product market -- 'organization main supplier' and 'few competitors'. They are derived from the variable reported in Table 5 above. The excluded category is 'many competitors'. Neither of these competition variables achieved significance. In column 3 we now add two dummy variables to

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[7] The inclusion of such a variable was first suggested by Machin and Wadhwani (1991).

pick up the nature of the demand for the product -- excluded category is 'stable' demand. They have the expected signs -- growing demand increases employment and falling demand lower it. Encouragingly the addition of these variables has little effect on the other coefficients. Once again the competition variables are insignificant. In a large number of experiments we conducted they were never found to be significant. Hence, in order to preserve sample sizes to reasonable levels they were omitted from column 4 and all subsequent specifications in the paper. We could find no evidence that employment growth in Great Britain was correlated with market structure which is consistent with the recent work of Blanchflower and Machin (1995) using these same data who found that labor productivity was not raised by more competition.

In Table 7 we present results for establishments with at least 25 manuals and 25 non-manuals respectively. The reason for this is that a series of questions were asked about the effects of introducing technology on manual/non-manual workers as long as there were at least 25 present. Column 1 simply involves re-estimating column 1 of Table 6 on this smaller subset. The results are very similar to those reported in Table 6. In column 2 the same sample is used as in column 1 but now the technology variable is changed to one specifically relating to manuals and the results are unchanged. Columns 3 and 4 repeat the exercise for white-collar workers. The organization change variables enter significantly negative in the first three columns but not in the fourth. The introduction of new technology appears to lower job growth by approximately 3%-4% per annum. The result is similar whether it affected the manual or the non-manual workforce.

The main difference between Table 6 and Table 7 is that the dummy 'union manual+non-manual' is nearly statistically significantly negative in column 1 as is the 'union manual only' dummy when the sample is restricted to workplaces with 25 or more manual workers. A similar story applies in column 2 when the introduction of technology was reported as directly affecting the manual workforce. The two manual union dummy variables were then combined as they had the same coefficient (results not reported) and the new variable had a coefficient of -.067 with a t-statistic of 2.17 in both column 1 and 2. (The coefficient is the same if instead we use a union recognition dummy). Analogously in columns 3 and 4 the 'union non-man only' dummy is

marginally significant when the change of technology relates to non-manuals. Unions appear to have lowered employment growth between 1987 and 1990 by an average of approximately 2% per annum. This is consistent with evidence from some earlier work by one of the authors of this paper which found the effect of unions on employment growth to be 2.5% per annum in 1980 using the first WIRS survey (Blanchflower and Oswald, 1990) and approximately 3% in 1984 using the second WIRS survey (Blanchflower, Millward and Oswald, 1991). Hence, there appears to be a strong negative correlation in the data between unionism and employment growth in all three of the WIRS surveys of roughly the same order of magnitude.

In all of the specifications in Tables 6 and 7 the technology variable is positive and significant and the organizational change variable is significantly negative with the exception of the final column. Interestingly enough there is very little variation in the size of the effect of the introduction of technology on job growth. On average per annum introducing new technology, whether it be related to the blue-collar or white-collar workers, raises employment growth by 2.5%-3.5%[8]. Introducing new work practices or work organization lowers job growth by 2%-3% per annum.

As we noted above, respondents who responded that new technology had been introduced at the establishment were asked about the nature of the technology, and particularly whether it involved micro-electronics and computers. In column 1 of Table 8 we re-estimate equation 3 of Table 6 replacing the new technology dummy (mean=.420) with one to represent the introduction of micro-technology (mean=.293). Once again the variable has a positive significant coefficient, with the other coefficients largely unchanged. In columns 2-4 the technology variable relating to non-manuals (mean=.570) is replaced in turn with dummies for the introduction of computers, word-processors and other micro-electronics (means of .527, .438 and .350 respectively). It should be noted that they are not mutually exclusive categories[9]. In all three cases the coefficients are positive

[8] The results were very similar if we restricted our sample to manufacturing. The effect on job growth was at the top of the above range at around 3.3%.

[9] The variables are highly correlated. For example the correlation between the introduction of computresr and word-processors was .77 and 'computers' and 'other' was .61. If more than one of

and approximately +0.08. The introduction of micro-electronics is positively correlated with job growth. As was found in Table 6 for the more general technology measure, on average the introduction of microtechnology raises employment growth by around 2.5% per annum.

Turning to Table 9 we can break the effect down by looking at interactions of new technology with different base size bands. This produces some quite interesting results. For establishments initially less than 100 in size, there is a weak positive effect; for establishments between 100 and 500, there is a strong and significant positive effect; while for establishments over 500, there is essentially no effect. These results appear relatively robustly across all the specifications whether the sample is restricted to workplaces with ≥25 manuals (column 2) or ≥25 non manuals (column 3). Technology introduction has a bigger impact on employment growth in establishments that are between 100 and 500 in size in the base year.

In Table 10 we report equivalent results for Australia based on a 1 year employment change. Similar controls, based on very similar questions, are used to those described above for Britain -- 42 industry dummies, single independent dummy, 2 demand dummies, a union dummy and 5 age dummies and a lagged dependent variable and an 'introduction of new technology' dummy. This has a positive coefficient and is significant at the 5% level on a two tail test. The age dummies and the lagged employment size dummies work in a similar way to those in Tables 7 and 8 for Britain. However, in the Australian equations neither the demand dummies nor the union dummy were significant. We also experimented with a number of variables to proxy product market competitiveness which were everywhere insignificant and were once again omitted[10]. Given that the introduction of new technology relates to a two year change its introduction raises job growth by just over 1.5% per annum. When we restricted the sample to manufacturing the effect increased to

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these highly correlated variables are included together there are multi-collinearity problems and they are all insignificant.

[10] Blanchflower and Machin (1995) also found no evidence of market competition influencing labor productivity in Australia as a whole. However, they did find some evidence of a positive impact in manufacturing. When we re-estimated equation 1 for manufacturing none of the competition variables were significant.

approximately 2.5% (results not reported). These equations for manufacturing were very similar to those in table 9 except the 'demand rising' variable was positive and significant.

In the AWIRS survey there were a number of other questions relating to organizational change over the preceding two years, including whether or not there had been any organizational change. These included changes in ownership, changes in products and services, changes in management as well as organizational change. None of these variables ever achieved significance at conventional levels and hence the results are not reported.

In column 2 of Table 10 the technology dummy is replaced by six interaction terms as in Table 8 for Britain. Here the technology dummy was interacted with six dummies reflecting establishment size in the base year. The larger the initial size of the workplaces the higher is employment growth following the introduction of new technology. We also experimented further with other interactions with the union status, a manufacturing dummy and a number of competition variables without success.

A summary of our findings might be the following:

1) The introduction of new technology is more likely to be associated with job growth rather than job decline in both countries.

2) The scale of the effect of introducing new technology on job growth was roughly similar in the two countries at around 1.5% per annum in Australia and 2.5% in Great Britain.

3) New technology has a bigger impact on employment growth in larger workplaces.

4) The existence of a union lowers employment growth in Britain but not in Australia.

5) Employment growth is lower in both countries the larger is employment size in the base year

6) Employment growth is reduced in both countries the longer the establishment had been operating.

5. CONCLUSIONS

In this paper we have analyzed two complementary datasets which have a number of (common) weaknesses and strengths. We believe the latter outweigh the former and so make these useful datasets to study. Rather contrary to our expectations, we find very similar relationships in

the data in these two countries. There is some evidence that the introduction of new technology is associated with higher employment growth and that this varies by establishment size. We could find no evidence from either country that employment growth varied by the degree of product market competition. Employment growth in Great Britain was lower in the union sector than in the non-union sector: in the more highly unionized Australian economy we could find no such effect. Job growth and the introduction of new technology appear to be complements rather than substitutes. The Luddites were wrong.

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Figure 1: Standardised UK and Australian Unemployment Rates, 1974-1993

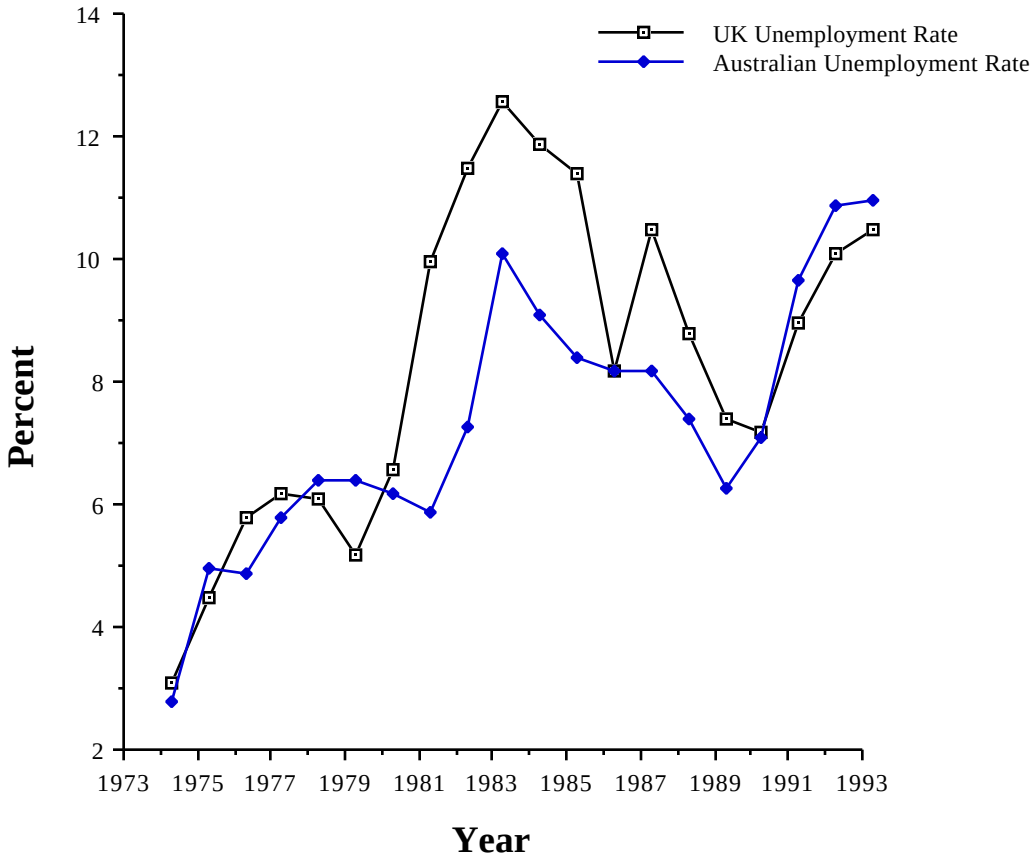

Table 1a: Frequency Distribution of Innovation by Base Year Size: Australia (private sector)

Base year size -- 1989	Introduce New Technology?	
	Private Sector	Manufacturing
25 - 49	32.4	47.9
50 - 99	35.1	45.4
100 - 199	40.3	49.8
200 - 499	37.5	48.7
500 - 999	40.4	50.9
1000 +	66.2	70.2
All	35.2	47.8

Table 1b: Frequency Distribution of Innovation by Base Year Size: Britain (private sector)

Base Year Size -- 1987	Introduce New Technology?	
	Private sector	Manufacturing
25 - 49	44.3	52.2
50 - 99	47.6	65.8
100 - 199	62.8	70.3
200 - 499	69.8	75.3
500 - 999	83.7	81.7
1000 +	81.3	92.3
All	52.1	66.0

Table 2a: Employment Growth and the Introduction of New Technology: Australia

	All		Private Sector	
	Introduce new technology?		Introduce new technology?	
	Yes	No	Yes	No
Mean 1 year employment growth rate (%)	2.94	3.24	2.81	2.56
Mean 1 year size-weighted employment growth rate (%)	2.79	-0.10	3.55	-0.82
Observations	590	943	339	556

Table 2b: Three year employment Growth and the Introduction of New Technology: Britain

	All		Private Sector	
	Introduce new technology?		Introduce new technology?	
	Yes	No	Yes	No
Mean 3 year employment growth rate (%)	11.77	8.73	14.51	11.21
Mean 3 year size-weighted employment growth rate (%)	5.83	6.45	8.38	10.34
Observations	886	471	662	342

Table 3a: One Year Employment Growth Rate by Base Year Employment Size (%): Australia (private sector)

Base Year Size: 1988	Introduce New Technology?	
	Yes	No
25 - 49	7.16	10.9
50 - 99	-1.09	-1.20
100 - 199	2.24	-4.55
200 - 499	0.49	-6.94
500 - 999	-0.66	-4.08
1000 +	-1.80	-2.09

Table 3b: Three Year Employment Growth Rates by Base Year Employment Size (%): Britain

Base Year Size: 1987	Introduce New Technology?	
	Yes	No
25 - 49	17.8	12.9
50 - 99	19.1	11.3
100 - 199	7.3	4.3
200 - 499	4.3	8.9
500 - 999	-0.9	5.00
1000 +	18.5	21.0

Table 4a. One year employment growth rates (%) by union status (private sector): Australia

Union status	Introduce New Technology?		
	Yes	No	All
Non-union	2.20	3.45	3.01
Union	3.04	2.24	2.52
All	2.81	2.56	2.65

Table 4b. Three year employment growth rates (%) by union status (private sector): Great Britain

Union status	Introduce New Technology?		
	Yes	No	All
Non-union	15.31	14.83	15.06
Union	13.85	7.59	10.90
Both (M+N)	8.31	0.90	5.26
Manual only	24.88	9.21	15.54
Nonmanual only	9.12	21.35	12.93
All	14.51	11.21	12.87

Table 5a. One year employment growth rates (%) by degree of competition in product market: Australia (private sector)

Base Year Size:	Introduce New Technology?		
	Yes	No	All
No competitors	-1.12	-1.49	-1.20
Few competitors	3.31	0.49	1.48
Many competitors	1.39	2.21	1.92
All	2.81	2.56	2.65

Table 5b. Three year employment change rates (%) by degree of competition in product market: Great Britain (private sector)

Base Year Size:	Introduce New Technology?		
	Yes	No	All
Organization main supplier	5.12	6.50	5.73
Few competitors	14.18	12.37	13.16
Many competitors	16.96	11.43	14.02
All	14.51	11.21	12.87

Table 6. Three year employment change equations -- Great Britain

	(1)	(2)	(3)	(4)	(5) Means
Dependent variable					.0623
New technology	.0792	.0884	.0848	.0958	.6659
	(3.77)	(3.51)	(3.42)	(3.94)	
Organizational change	-.0210	-.0447	-.0633	-.0489	.2926
	(1.02)	(2.00)	(2.77)	(2.18)	
Log N_{t-3}	-.0765	-.0750	-.0626	-.0651	5.2741
	(8.63)	(7.70)	(6.01)	(6.38)	
≥ 2 but under 5 years	-.0462	-.0122	-.0591	-.1057	.1021
	(0.75)	(0.18)	(0.82)	(1.51)	
≥ 5 but under 10 years	-.0299	.0515	-.0424	-.1176	.1129
	(0.50)	(0.78)	(0.60)	(1.74)	
≥ 10 but under 20 years	-.1261	-.1018	-.1622	-.1893	.1862
	(2.20)	(1.59)	(2.44)	(2.94)	
≥ 20 years	-.1245	-.0818	-.1273	-.1765	.5679
	(2.25)	(1.33)	(2.00)	(2.87)	
Single establishment	.0137	.0249	.0663	.0355	.1672
	(0.53)	(1.12)	(1.14)	(0.65)	
Demand rising			.0682	.0895	.5919
			(2.69)	(3.38)	
Demand falling			-.0824	-.0668	.1482
			(2.60)	(2.12)	
Union - manual+nonman	.0235	.0227	-.0160	-.0093	.4374
	(0.87)	(0.77)	(0.51)	(0.30)	
Union manual only	.0203	.0058	-.0299	-.0121	.1505
	(0.68)	(0.18)	(0.82)	(0.34)	
Union - nonman only	-.0550	-.0937	-.1256	-.1027	.0707
	(1.24)	(1.83)	(2.19)	(1.98)	
Organisation main supplier		.0217	.0096		.0703
		(0.60)	(0.27)		
Few competitors		.0141	.0257		.3011
		(0.63)	(1.10)		
N	987	812	657	710	
$\bar{R}^2$	.1921	.2078	.2141	.2176	
F	4.91	4.49	3.84	4.23	

Table 7. Three year employment change equations -manuals and non-manuals -- Great Britain

	Manuals (1)	Manuals (2)	Non-manuals (3)	Non-manuals (4)
New technology	.1068		.1193	
	(4.03)		(4.14)	
New tech - manuals		.0924		
		(3.71)		
New tech - nonmanuals				.0791
				(3.07)
Organizational change	-.0524		-.0495	
	(2.19)		(1.99)	
Organization Δ - manuals		-.0699		
		(2.92)		
Organization Δ - nonmanual				-.0202
				(0.81)
Log N_{t-3}	-.0591	-.0546	-.0621	-.0630
	(5.26)	(4.95)	(5.24)	(5.26)
≥ 2 but under 5 years	-.0428	-.0552	-.0233	-.0279
	(0.48)	(0.61)	(0.28)	(0.33)
≥ 5 but under 10 years	.0345	.0281	-.1126	-.1111
	(0.42)	(0.34)	(1.37)	(1.34)
≥ 10 but under 20 years	-.1023	-.1086	-.1551	-.1529
	(1.30)	(1.38)	(2.03)	(1.99)
≥ 20 years	-.0944	-.1015	-.1177	-.1181
	(1.24)	(1.34)	(1.64)	(1.64)
Single establishment	.0345	.0298	.0554	.0631
	(0.62)	(0.54)	(0.96)	(1.09)
Demand rising	.0705	.0779	.0859	.0847
	(2.69)	(2.99)	(3.06)	(3.01)
Demand falling	-.0575	-.0537	-.0709	-.0769
	(1.77)	(1.65)	(1.97)	(2.14)
Union - manual+nonman	-.0641	-.0644	.0065	.0120
	(1.91)	(1.92)	(0.18)	(0.33)
Union manual only	-.0639	-.0655	-.0046	.0076
	(1.75)	(1.79)	(0.10)	(0.16)
Union - nonman only	.0851	.1857	-.0937	-.0948
	(0.48)	(0.73)	(1.75)	(1.76)
N	577	576	562	560
$\bar{R}^2$	.2367	.2370	.1942	.1752
F	3.93	3.93	3.37	3.08

Table 8. Three year employment change equations - microtechnology, computers etc. - Great Britain

	Manuals (1)	Non-manuals (2)	Non-manuals (3)	Non-manuals (4)
Micro-electronics - manuals	.0902			
	(3.74)			
Computers - Nonmanuals		.0888		
		(3.63)		
Word-processing Nonmanuals			.0816	
			(3.38)	
Other micro-electronics - Nonmanuals				.0781
				(3.17)
Organization Δ - manuals	-.0684			
	(2.87)			
Organization Δ - nonmanuals		-.0190	-.0183	-.0163
		(0.78)	(0.46)	(0.66)
Log N_{t-3}	-.0558	-.0632	-.0633	-.0659
	(5.04)	(5.30)	(5.30)	(5.48)
2 but under 5 years	-.0706	-.0189	-.0169	-.0220
	(0.78)	(0.22)	(0.20)	(0.26)
5 but under 10 years	.0103	-.1040	-.1003	-.1078
	(0.13)	(1.26)	(1.22)	(1.30)
10 but under 20 years	-.1298	-.1466	-.1365	-.1549
	(1.65)	(1.92)	(1.78)	(2.02)
≥ 20 years	-.1205	-.1110	-.1030	-.1153
	(1.59)	(1.54)	(1.43)	(1.60)
Single establishment	.0334	.0571	.0644	.0879
	(0.61)	(0.99)	(1.12)	(1.52)
Demand rising	.0758	.0842	.0853	.0902
	(2.91)	(3.00)	(3.04)	(3.22)
Demand falling	-.0581	-.0756	-.0752	-.0716
	(1.78)	(2.10)	(2.09)	(1.98)
Union - manual+non-manuals	-.0652	.0086	.0073	.0156
	(1.94)	(0.24)	(0.20)	(0.43)
Union manual only	-.0632	.0047	.0009	.0083
	(1.73)	(0.10)	(0.02)	(0.18)
Union - nonmanuals only	.1740	-.0999	-.0929	-.1020
	(0.69)	(1.86)	(1.73)	(1.89)
N	576	560	560	560
$\bar{R}^2$	.2374	.1812	.1784	.1762
F	3.93	3.17	3.13	3.10

All equations also include 51 industry dummies and a constant.

Table 9. Three year Employment Change Equations - Size of Establishment interactions

	All	Manuals	Non-manuals
	(1)	(2)	(3)
Technology interactions*			
25-49 employees	.0932	.0802	.1508
	(1.46)	(1.00)	(1.26)
50-99 employees	.0531	.0491	.0923
	(1.10)	(0.92)	(1.31)
100-199 employees	.1096	.1525	.1194
	(2.02)	(2.50)	(2.00)
200-499 employees	.1311	.1036	.0937
	(2.51)	(2.09)	(1.80)
500-999 employees	.0439	.0434	-.0142
	(0.59)	(0.69)	(0.25)
≥ 1000 employees	.0180	.0355	.0469
	(0.27)	(0.63)	(0.88)
N	710	576	560
$\overline{R}^2$	.2071	.2255	.1636
F	3.68	3.43	2.68

Notes: column 1 involves interactions with dummy variable for introduction of new technology that affects the manual or non-manual workforce or both. Column 2 relates specifically to changes affecting the manual workforce and column 3 to the non-manual workforce.
All equations also include 51 industry dummies, 3 union dummies, 2 demand dummies, 4 age of establishment dummies, five size of establishment dummies, an organisational change dummy and a constant.

Table 10. Three year Employment Change Equations - AWIRS

	(1)	(2)	Mean
Dependent variable			.0246
New technology	.0330		.3661
	(1.96)		
Log N_{t-1}	-.0594	-.0734	4.6671
	(6.87)	(6.81)	
≥2 and < 5 years	-.1673	-.1683	.0721
	(2.87)	(2.89)	
≥5 and < 10 years	-.1557	-.1560	.1163
	(2.79)	(2.80)	
≥10 and < 20 years	-.1638	-.1633	.2417
	(3.09)	(3.09)	
≥20 and < 50 years	-.1676	-.1713	.3643
	(3.22)	(3.30)	
≥50 years	-.1604	-.1623	.1785
	(2.98)	(3.02)	
Single establishment	.0682	-.0607	.1784
	(3.03)	(2.69)	
Demand rising	.0173	.0121	.4950
	(0.98)	(0.68)	
Demand falling	-.0217	-.0263	.1509
	(0.86)	(1.04)	
Union	-.0028	-.0029	.7928
	(0.12)	(0.12)	
Technology interactions*			
25-49 employees		.0384	.0806
		(1.21)	
50-99 employees		-.0313	.1019
		(1.15)	
100-199 employees		.0432	.0840
		(1.47)	
200-499 employees		.0695	.0560
		(1.86)	
500-999 employees		.1073	.0370
		(2.28)	
≥ 1000 employees		.1539	.0190
		(2.32)	
N	889	889	
$\overline{R}^2$	.0594	.0671	
F	2.31	2.33	

DATA APPENDIX

This paper uses data from two sources: the 3rd Workplace Industrial Relations Survey (WIRS 3) in 1990 in the UK, and the 1st Australian Workplace Industrial Relations Survey (AWIRS), in 1989. The methodology and questionnaire were very similar in the two surveys.

1. British 1990 Workplace Industrial Relations Survey (WIRS3):

There are three Workplace Industrial Relations Surveys, that took place in 1980, 1984 and 1990. The sample design for the 1990 main survey broadly followed that developed for previous surveys. The sampling frame was the Employment Department's 1987 Census of Employment (for the 1984 survey it was the Census conducted in 1981; and for the 1980 survey it was the Census conducted in 1977). As in previous surveys, all Census units recorded as having 24 or fewer employees were excluded, as were units falling within Agriculture, Forestry and Fishing (Division 0) of the Standard Industrial Classification (1980). Otherwise all sectors of civil employment in England, Scotland and Wales were included in the sampling universe (public and private sector, manufacturing and service industries). In 1990, as in previous surveys, larger units (on the basis of number of employees) were over sampled.

A Census unit is, in most cases, a number of employees working at the same address who are paid from the same location by the same employer. The requirement of the survey design was for a sample of establishments (that is, individual places of employment at a single address and covering all the employees of the identified employer at that address). In general, there is a sufficient degree of correspondence between Census units and establishments for the Census to serve as a viable sampling frame for the survey series. However, some Census units have been found to refer to more than one establishment and in others to just part of an establishment.

At the time of the design of the 1990 sample, the 1987 Census of Employment file contained just over 142,000 units with 25 or more employees, which is slightly more than the 135,000 in the 1981 Census used for the 1984 survey. A stratified random sample totaling 3,577 units was drawn (in 1984 the figure was 3,640 units and in 1980 the figure was 3,994 units). The selected sample was smaller in 1990 for two reasons. Firstly, the number of establishments at which interviews were required was 1,870, as against 2,000 in the first survey. Secondly, as none of the 'reserve pool' of nearly 500 units had been used in 1984 and the 1984 experience gave a good guide to the extent of out-of-scope and non-responding addresses, the size of the reserve pool in 1990 could be reduced. In the event none of the 358 units selected for the 1990 reserve pool were used.

The selection of units from the Census file involved an initial division of the file into seven files, each containing units within a size range: 25 to 49 employees, 50 to 99 employees, and so on. Within each file the Census units were then re-ordered by: the proportion of male employees, within the proportion of full-time employees, within the Activities of the Standard Industrial Classification (SIC). Differential sampling fractions were applied to the six lower size bands, the seventh (top) band having the same sampling fraction as the sixth band. From the re-ordered lists, samples were selected by marking off at intervals from a randomly selected starting point, the list being treated as circular.

The range of sampling fractions employed has been progressively increased during the course of the series. Partly this was because the number of large units in the population has declined and we still wanted to have sufficient large establishments of different sizes. It also reflected an increased emphasis on estimates focusing on employees rather than establishments. Analysis of the 1980 results had shown that employee estimates could be improved with little loss of accuracy on establishment estimates if the sample contained more large, and fewer small, units.

Besides the withdrawal of the ten per cent of addresses for the reserve pool, the sample selected in 1990 was also reduced by a further 210 addresses from SIC Classes 91, 93 and 95. This innovation was made because analysis of the previous surveys had demonstrated that there was less variation within these easily identifiable parts of the public sector on most of the matters of interest in the surveys. It seemed advisable, therefore, to spread the survey resources that could be saved by under sampling these sectors over the remaining sectors of the population. The result of these two types of withdrawal from the selected sample -- the reserve pool and the under sampling of Classes 91, 93 and 95 -- was to bring the number of units in the initial sample down to 3,009.

In 1984, all addresses in the deep coal-mining industry had been withdrawn from the sample prior to fieldwork, owing to the industry-wide dispute current at the time. In 1990 the deep coal-mining industry was again excluded so that the industrial coverage of the three surveys in the series would be identical.

Interviewing started in late January, shortly after the main interviewer briefings, and continued until September 1990, with the bulk of interviews taking place between February and April. The median date for the main management interviews was late March, compared with May for the two previous surveys. The final sample size was 2061 establishments.

2. Australian 1989/90 Workplace Industrial Relations Survey (AWIRS):

The units of analyses for AWIRS are called locations, which the Australian Bureau of Statistics (ABS) defines as 'a single physical area occupied by the establishment from which It engages in productive activity on a relatively permanent basis'. The ABS classifies workplaces in a number of ways, including locations, establishments of enterprises. 'Locations', such as a bank branch of a council works depot, are a smaller classificatory unit than establishments which may control or be responsible for a number of locations - for example, regional bank offices or council chambers are establishments. An enterprise can cover all the operations in Australia (locations in all establishments) of a single operating legal entity. These definitions apply to both the private and public sectors. Single one-location workplaces that are not part of a larger organization - for example, an independent hairdressing salon or news agency - would appear in each of these classificatory independent hairdressing salon or news agency - would appear in each of these classificatory levels. Further, a head office of an organization may be classified as a location and/or an enterprise, depending on its organizational character.

Because the AWIRS sample - head offices, regional offices, worksites and branches, as well as single or independent workplaces that were not part of a larger enterprise group. When a workplace address housed complex and diverse organizational structures or administrative units, in terms of industrial relations, it was regarded as consisting of several separate workplaces. In such cases, the survey reviewed the industrial relations structures and practices of the workplace (or part of the organization) with the greatest number of employees. Problems also arise with multi-location organizations when a number of workplaces may be controlled centrally This is because industrial relations practices and structures may be determined elsewhere in the organization. To minimize the effect of these problems the questionnaires were designed to measure workplace autonomy and dependence within the organization.

AWIRS consist of two surveys. First, a survey was conducted of 2004 workplaces with a minimum of twenty employees covering all States and Territories and all industries with the exception of agriculture and defense. This involved face-to-face interviews with approximately 4500 managers and, where present, union delegates. This is the data we use. Second, a survey of managers was conducted by telephone at 349 workplaces with between five and nineteen employees. It used a shorter questionnaire covering general industrial relations matters and some specific issues relevant to workplaces with a small number of employees. The sample frames for both surveys were designed by the Statistical Consultancy Section of Australian Bureau of

Statistics (ABS) on the basis of Department of Industrial Relations (DIR) specifications. The sampled workplaces were drawn from the ABS register of all establishments in Australia. The population frame for the personal interview survey included all workplace locations with twenty of more employees, excluding the agriculture, forestry, fishing and hunting and defense industries. These industries were excluded because of sampling difficulties in the agricultural sector and the unique nature of industrial relations in the defense industry. The sample frame was stratified into metropolitan (capital cities only) and non-metropolitan workplaces, and further stratified by the eight States and Territories, four employment-size bands and twenty one industry groups. The sample was also designed to produce equal relative standard errors for specified employment group estimates. AWIRS sampled a greater number of large workplaces than if workplaces had been selected by a simple random method. This was to allow for analysis by size. As most of Australia's workforce is employed by a relatively small number of large workplaces, this ensured the survey covered workplaces that employ the majority of the workforce. The sample included approximately 1 in 33 workplaces with twenty to forty-nine employees, 1 in 13 workplaces with fifty to ninety-nine employees, 1 in 9 workplaces with between 100 and 499 employees and 1 in 2.2 workplaces in the 500 and more size band. The sampling technique used for AWIRS required that weighted data be used for population estimates of workplaces or employment numbers. The non-metropolitan sample was clustered by postcode.

Interviews were conducted in an average of five workplaces per 100 of the possible 1000 non-metropolitan postcodes. The sample for the small workplace telephone survey was less complex and allowed for national estimates of workplaces with between five and nineteen employees. Because there are about 92,000 workplaces with between five and nineteen employees, the average sampling fraction for the telephone survey was 1 in 260. The sample was designed to allow disaggregation and reliable estimates for public and private sector workplaces, manufacturing and non-manufacturing workplaces; organizational status of workplaces; and two size bands. Data from this survey can be combined with the data from the survey of workplaces with twenty or more employees to allow some comparisons between small and large workplaces.

Appendix Table 1: Size, Age and Industry Distribution of Establishments in Britain and Australia, (%)

	Australia		Britain	
	Unweighted	Weighted	Unweighted	Weighted
Current Year Size:				
25 - 49	23	42	17	53
50 - 99	28	30	17	25
100 - 199	22	16	18	13
200 - 499	14	8	17	7
500 - 999	8	2	13	2
1000+	5	1	18	1
Age:				
< 2 years	3	3	3	3
≥2 and < 5 years	6	6	9	11
≥5 and < 10 years	9	10	10	13
≥10 and < 20 years	21	21	18	22
≥20 years	61	59	58	49
Industry:				
Manufacturing	25	21	31	21
Utilities	3	2	3	1
Construction	5	5	3	5
Trade	16	18	15	21
Transport	5	4	4	4
Communications	3	2	3	3
Banking etc.	11	11	10	13
Public Admin.	5	5	8	7
Commercial Srv	20	23	20	22
Other Services	8	9	3	3
Total	1841	26932	2061	2000

Appendix Table 2: Job Creation and Destruction in Britain and Australia, (%)

	Australia	Britain
Employment Growth Rate	1.18	0.29
Job Creation Rate	6.18	5.59
Job Destruction Rate	5.00	5.30
Job Reallocation Rate	11.17	10.89
XS Job Reallocation Rate	9.99	10.61
Observations	1533	1707

These are calculated using the Davis-Haltiwanger denominator, but do not include births or deaths. These are annual rates and relate to the economy as a whole.