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Skill shortages and the absence of wage pressures

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CONTENTS

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Executive summary

Aim

- This study addresses the question of why persistent skill shortages in some occupations in Australia do not appear to be causing significant wage pressures. In particular, the role of Enterprise Bargaining Agreements (EBAs), which commenced in the early 1990, is examined.
- EBAs may dampen wage inflation if they reduce the degree of wage flow-on, that is, the extent to which wages in one labour market follow wage increments gained in unrelated labour markets. EBA legislations have not been designed to directly address this mechanism: there are no clauses limiting or penalizing the use of comparative wage justice principles to determine wages. Furthermore, there is no *a priori* reason or evidence to suggest that enterprise-level negotiations are more occupation specific than (centralized) industry-level negotiations. However, to the extent enterprise-level productivity bargaining is encouraged relative to other forms of wage bargaining (such as comparative wage justice bargaining) then EBAs may have an indirect bearing on wage inflation.
- It is neither efficient nor desirable for EBAs to limit wage increases outright. Productivity-wage trade-offs enhance both firm and employee well-being without impacting adversely on other groups in the community. Furthermore, if EBAs have made wages more elastic with respect to skill shortages, that is, if wages have become more likely to increase when a shortage appears, then EBAs can be said to have had a beneficial impact on how well the labour market allocates scarce labour between competing uses.

Results

- Both the ABS vacancy series and the ACCI-Westpac Difficulty of Finding Labour series indicate that the aggregate labour market has continued to tighten since the early 1990s. However, there is little evidence of a significant rise in the rate of wages growth since the mid-1990s. In fact growth in employee earnings

ranged between 3 and 4 per cent per annum between the late 1990s and 2005 despite strengthening demand for labour, and in particular skilled labour.

- Skill shortages were found to be positively associated with wage increases in the occupation of shortage. There is some weak evidence that this relationship is more pronounced in the 1995-2005 period.
- Outside Wages: Wage increases in one occupation within an industry were not found to influence 'outside' wages, that is, wages for the same occupation but in other industries. This lack of influence on outside wages runs through the whole of the 1991-2005 period.
- Flow-on Wages: There was evidence that wage increases in one occupation within an industry 'flowed-on' to other occupations within the same industry. There is clear evidence that these spill-over effects have become weaker after 1994.
- Examination of the 1991-1994 and the 1995-2005 periods indicates that the Australian labour market changed in the mid-1990s. Specifically, the strength of flow-on wage increases, which are one of the more pernicious forms of comparative wage justice, fell over the 1990s. This implies that the bargaining transmission mechanisms were found to be weaker in the post-1994 era. One could link this result with the labour market institutional changes introduced in the mid-1990s. This would imply that the market works in a sharper manner post-1994.
- Both skill shortages and EBAs were found to be positively associated with wage rises. In those cases where EBAs were introduced in the absence of skill shortages, wage increases were above the average in the labour market, presumably indicating that EBAs reflect either already achieved or successfully motivated productivity increases. In those cases where EBAs were introduced in the presence of skill shortages, further wage increases are observed than those that would have been warranted by the skill shortages alone, but in a diminishing manner. In the latter case, EBAs are hampering the clearing of labour markets by artificially dampening wage rises for occupations in demand.

- The overall picture that arises from this study is that skill shortages are associated with above average wage increases, but in a benign and useful manner, as a market signal for improving the allocation of human resources in the labour market.
- The association between EBAs and flow-on wages was positive which suggests that the forces that encourage enterprises to enter into an EBA also make them more prone to granting higher flow-on wage rises within the firm.
- Altogether, our results suggest that while the labour market has changed – for the better, in terms of reduced flow-on wage rises – during the 1990s, this development cannot be attributed directly to EBAs.

Method

- The study uses a combination of data sources to construct a panel of wage rates for 'jobs' in specified occupation and industry combinations between 1989 and 2005.
- We develop an augmented-partial adjustment model to estimate the associations between wage increases, skill shortages and the presence of EBAs in the Australian labour market.

Data development

- To enable more precise analysis of skill shortages in the future, more detailed data on vacancies, including vacancy durations, should be collected. This would permit the government to speak with authority on the issue of skill shortages. Details should as an absolute minimum include qualifications or occupation and location.
- This study has been restricted to the impact of collective bargaining on moderate wage rises in the presence of skill shortages. Ideally we would like to have examined the impact of individual bargaining as well. However we have been hampered by the availability of data – for example, data on method of setting pay is only available back to 2000. It would be useful to establish the impact of increased incidence of individual bargaining on wages as compared with the impact of collective bargaining. It would be also useful to ascertain whether a

greater incidence of individual bargaining would assist in clearing the market for occupations that are experiencing skill shortages.

- Further research on the determinants of wages would be enhanced by the dedicated collection of employer-employee panel data which would allow more detailed and accurate economic modelling and micro-econometric analysis.

1. Introduction

In the last two decades, there have been claims of skill shortages in several occupations ranging from Health Professionals and Education Professionals, to Electrical and Electronic Tradespersons and Automotive Tradespersons. The conventional economics position in such a situation would be that employers should increase wage offers in order to signal these shortages to potential employees. Subsequently, these higher wages should attract additional human resources to cover these shortages. Historically, it has been common for these wage increases to flow through to other jobs that are not in short supply but have customarily aligned their wage rates with the former group. While wage increases for occupations in shortage have a positive economic function, wage increases to occupations that do not share the same labour supply conditions do not and they merely serve to create wage inflation.

It is important to know and be aware of the distinction between efficiency-enhancing wage rises and deleterious wage rises. Suppressing both types of wage growth is not in the interests of the economy. One of the more simple ways to overcome a skill shortage in the short-run is to offer higher wages to attract existing skilled people from outside the occupation.[1] In the long-run these wage increases will also increase demand for occupational specific training and education. They provide people with an incentive to seek and undertake work that uses their skills and aptitudes more productively. This requires that wages vary to reward employees who improve their productivity in their

[1] In the case of licensed or credentialed occupations, attraction is limited to qualified people who may be working outside their occupation of training or are not in the labour force. Most importantly, higher wages should lower attrition rates of skilled people from their occupation of training. The high numbers of qualified people working outside their occupation of training has been well documented and includes most trades, nurses, teachers *inter alia* (Thomas 1988b, Thomas 1988a, Webster et al. 2001, Webster 1999, Webster et al. 2006).

current job and also motivate employees to move into occupations and industries where their skills may be in short supply.[2]

In reality, there are a variety of reasons why wages may not perform in the expected manner. In a bargaining situation, the relative bargaining power of employers vis-à-vis employees may dominate wage determination leaving limited scope for relative labour market balance to affect wages. Thus, not only will the more productive employees get a pay rise, but also the ones that have strong bargaining positions. Another possibility may be that, in a market with imperfect information, imperfect matches can be made due to employer and employee search costs. Search costs can induce employers and employees to stop searching not when the best possible match has been identified, but when it is not economical to continue searching (simply put, search will stop when the possible gains to be made by continuing to search are smaller than the cost of searching longer). In both examples the real life result may be that the employee with the highest relative demand potential is not the one who actually gets a pay rise or a better job, and that the labour market delivers a sub-optimal outcome of misallocated human resources.

If skill shortages only increase the wages of the specific occupation/industry in shortage, then the signal transmitted by the higher wage will increase allocative efficiency without imposing a burden on any neighbouring occupations and/or industries. If, however, due to the nature of the wage determination process, the effect of narrowly-defined skill shortages spreads to higher wages throughout the wider economy (that is, if there are spillover effects in the form of higher wages in occupations and/or industries where there are no skill shortages), then the conventional expectation is that inflationary wage pressures will appear as a result of skill shortages.

[2] Wages here can be thought of as a good approximation of overall packages which may also contain other non-pecuniary or indirect benefits associated with the employment contract. Some differences will be present between jobs, but looked at from the point of view of the whole economy, the wage level is the most dominant factor in labour market decisions.

There are alternative *a priori* mechanisms through which wage increases may spill over from occupations in shortage to occupations not in shortage, which will be discussed below. In general, the outcome of skill shortages will depend to a large degree on the freedom and flexibility of the labour market. For example, where bargaining is constrained by non-economic forces (e.g. regulations or socio-cultural institutions defining relative pay, trades unions) one would expect that wage rises will spread beyond the occupations and industries where shortages are experienced. Alternately, where training quality and accreditation accuracy may not be sufficient, the uncertainty they introduce will result in a spread of wages amongst employees which cannot be warranted by the actual spread of productivity amongst them.

The following Box 1 gives an overview of the empirical routes through which skill shortages and wage increases may be related.

BOX 1

THE RELATIONSHIP BETWEEN SKILL SHORTAGES AND WAGES INCREASES.

Skill shortages increase the wages in the occupations in shortage. **Wage increases in occupations that are in shortage serve a useful purpose as they signal to those currently in the labour market that there are some financial gains to be made by re-training. Wage increases also provide a positive signal to those outside the labour market, particularly young people and those considering re-entering the labour market, to consider a career in those occupations in shortage.. Where these effects are observed we can say that the market is doing its job and resources are being allocated in an efficient manner.**

Wage increases in occupations that are not in shortage, **but may be close substitutes of occupations in shortage may serve a useful purpose, at least in the short-run, by providing a temporary substitute for the skills in shortage until sufficient training has taken place to generate the right skills.**

Skill shortages that persist over time **without resulting in wage increases in that occupation should be examined carefully. The wage setting framework should be questioned, in that it may be simply keeping wages artificially low, causing inefficiencies in production. The speed and effectiveness of training should be examined. The data that generates this observation should also be examined, in that it may contain measurement error, thus conveying the wrong message.**

Wage increases in occupations that are not in shortage **and are not substitutes of occupations in shortage, but are in some way neighbours to them (e.g. they belong to the same workplace, industry, wage setting group and other) are the most likely to result in economic damage. First, they are likely to generate inflationary pressures. Second, they will convey the wrong training message resulting in generating more workers with skills that are not in shortage.**

This study addresses the question of "why observed skill shortages in Australia do not appear to be causing wage pressures". An important empirical question is, the degree to which wages increases are related to shortages in the associated labour market compared with other forces which may have no economic role. Given the major legislative changes in the Australian labour market in the last decades, this study will also try to assess the effects of workplace reform, in particular the spread of enterprise bargaining, on wage

inflation in Australia, while controlling for other causes of wage pressure such as the price of imports and labour shortages.[3]

2. Overview of relevant theory and policy

2.1. The Australian Institutional and policy background

Wage increments, as a source of inflation, attracted strong attention during the 1970s when inflation soared to double digits. The response by governments was first to address inflation through macroeconomic policy and then, to deal with it through formal incomes policies, most notably a centralized wage negotiating agreement (The Accord 1983 to 1995). Since 1995, wage policies have not addressed the problem of inflation explicitly. Instead, the focus of these policies has been to encourage industries and firms to grant wage increments in lieu of productivity gains, aiming at highlighting the possible benefits of individual bargaining, in order to provide flexibility for employers and employees to negotiate directly on those working arrangements that best suit their individual circumstances. Insofar as a wage-productivity trade-off represents a non-inflationary wage negotiation (wage inflation occurs when the wage increases for a unit of labour of constant productivity) then policies that encourage a greater level of wage-productivity trade-off are indirectly anti-inflationary, especially when they are used as substitutes for other (inflationary) forms of bargaining.

Strictly speaking, all forms of job remuneration – workplace conditions, car and superannuation benefits *inter alia* – should be taken into account when we estimate the extent and effects of wage inflation. However, there is limited information on the

[3] Current academic research is largely inconclusive as to the net effect of enterprise bargaining on productivity, mainly because of the many other concurrent influences which do not allow the clear cut isolation of such an effect. The lack of this evidence has been highlighted in the literature by Wooden (2000) and Loundes et al. (2003). Connolly et al. (2004) have argued that CAs and AWAs increase productivity.

prevalence and magnitude of these benefits, and for reasons of expediency, we have limited our analysis to wages only.

One of the main contributions of the wages system to inflation is its relationship with wage flow-ons. Wage flow-ons represent wage increments that a group, such as an occupation in a specific industry, gains by appeal to the principle that they have always had, and therefore always should have, comparable wages to another group. Wage flow-ons are sociological in nature and are not underpinned by economic forces. By condoning wage increments on the basis of comparative wage justice, a wage setting system permits wage increases without examining if a parallel rise in labour productivity has occurred. Previous centralized incomes policies addressed the issues of wage flow-ons, but the system of EBAs has been relatively silent on this matter. For example, there are no clauses limiting or penalizing the use of comparative wage justice principles to determine wages in the EBA legislations. In addition, there is no *a priori* reason or evidence to suggest that enterprise-level negotiations are more labour market specific than (centralized) industry-level negotiations. However, to the extent enterprise-level productivity bargaining is encouraged relative to other forms of wage bargaining (such as comparative wage justice bargaining) then EBAs may have an indirect bearing on wage inflation.

Since the late 1980s, successive Federal Governments have enacted a series of incentives to encourage greater use of enterprise-level bargaining in the expectation that, by encouraging employers to sit down at the table with their own workers, more productivity-enhancing wage-work practice trade-offs would ensue. Multi-employer level negotiations have for some time been criticised as being pro-inflationary and for displacing other, more productive modes of bargaining (Calmfors and Driffil 1988, OECD 1997). While enterprise, workplace or individual negotiations have always existed and have never been disallowed, critics of the multi-employer system argued that they were effectively ‘crowded out’ by the habitual peak-body negotiations.

According to Dowrick (1993), enterprise-level bargaining may contribute to enhanced productivity either directly through the reduction in inefficient work practices or indirectly through making the work culture more conducive to innovation, skill development and knowledge transfer. The capacity of wages to apportion skilled labour to its best and highest use is one way that enterprise bargaining may assist in achieving these productivity ends. The incentives for single-employer negotiations included the removal of arbitration for stalled negotiations and the effective removal of the detailed systems of awards covering a broad range of industrial matters. While the *Industrial Relations Reform Act 1993* gave most impetus to enterprise bargaining, the *Workplace Relations Act 1996* had most impact on union power (Watts 2002, 2003). DEWR and OEA (2004) and other reports in this series provide an overview of the progress of EBAs.

2.2. Alternative theoretical foundations and their policy relevance

This section outlines possible underlying theoretical explanations for the link between persistent skill shortages and wage pressures. Basic economic theory concentrates on wages as the prime adjustment mechanism, implicitly assuming that, in the presence of skill shortages, wages will converge towards a higher market clearing level and shortages will be eliminated. Put simply, where employers cannot find the necessary skills they will either (i) pay higher wages (which will attract these skills), or (ii) decide to not produce (because the wage they would have had to pay would have made them a loss). Casual observation of labour markets will reveal that this textbook market clearing interpretation of the way wages are determined is not necessarily apparent, that the wages we observe are often far from the labour-market clearing level and that other adjustment mechanisms may be used by employers.

Several theories have been put forward trying to explain what happens in these cases. These range from wage disequilibrium theories (see the extensive work of Goldfeld and Quandt in this area) to institutional theories, which argue that wages play a minimal role and other forms of adjustment may be empirically more prominent. A number of

adjustments by employers to skill shortages have been highlighted in the literature, ranging from adjustments in hours worked, quality and/or quantity produced, inventories, internal and/or external substitution of skills, to capital/labour composition and others. The institutional environment has also been highlighted in the context of non-wage adjustments, in terms of the hiring and firing constraints, the training constraints and lags, cyclical factors and their relationship to possible implicit contracts with the workforce.

A review of this literature is well beyond the scope of this research, as the underlying economic framework is indeed very complicated. This section concentrates on those essential elements which allow the interpretation of the modelling that follows. It is evident from the data that some form of disequilibrium is at play, at least at the wage level. The precise source of this disequilibrium at the fundamental economic theory level is not obvious, as it may be due to several reasons and its examination, given the data at hand, is not feasible. This research puts forward the hypothesis that there may be some wage adjustment in response to the observed skill shortages and sets out to investigate empirically what its crucial correlates and determinants may be. This is done through attempting to estimate the degree to and the speed at which wages adjust over time, and what the determinants of these adjustments may be.

The focus of the research is to establish whether skill shortages within an occupation and industry influence the wages of: (i) the workers in shortage in that occupation and industry, (ii) the workers in shortage in that occupation and all other industries and (iii) the wages of those in all other occupations in that industry. The most natural interpretation for this research would be the bargaining model which concentrates on the relative power between employers and employees in the wage setting process, as the empirical version of this model naturally encompasses the underlying processes described above and does not need to be further specified for estimation.

The bargaining model argues that labour markets are typically characterised by investment in considerable sunk costs (of skill acquisition) by both parties which can make wages indeterminate with respect to market forces. Short-term demand functions will be discontinuous at the current wage: because of the costs of hiring and training new staff, a fall in wages will not necessarily lead to more hires and firms will 'hoard' workers if wages rise (Oi 1962). A parallel short-term supply function may also exist: because of the considerable investment in occupational education and training, workers will not immediately leave their employer or occupation if wages fall, nor will supply respond immediately to a rise in wages. If either or both these discontinuities exist, there is a range over which wages can vary with no short-run impact on employment. Within this range other forces, such as those operating through the bargaining system, may act to determine wages.

As such, in this study, we use a bargaining theory of wages to illustrate how wages in Australia are 'determined' and how this process has been influenced by the shift to enterprise bargaining over the past 15 years. There are two elements to the bargaining formula: the wage desired by workers and the power of workers to achieve this wage. The desired wage will be affected by past consumption habits and standards such that if prices rise, workers resist reductions in their real wage by demanding, or expecting, a higher nominal wage. What is most relevant here is the strength of the belief that certain levels of real wages are morally right and due to workers. The OPEC oil price rises of the 1970s are the classic example where (high) nominal wage rises were required by workers to maintain their habitual income levels. Other cases of this 'real wage resistance' can occur when real wages are eroded due to either a reduction in productivity or to a shift of incomes from wages to profits. Formally, the relationship between changes in consumer prices and this 'real-wage resistance' may depend on the source of the change in consumer prices, and whether the price changes are perceived as fairly distributed, unavoidable etc. The bargaining model argues that this real-wage-resistance norm leads workers to increase their desired wage in response to increases in either the price of imports or domestic profit margins.

A second factor forming workers' desired wage is their aspiration to maintain relativities with their peers. Formally, this comparative-wage-justice social norm leads wages to vary positively with observed increases in the wages of other workers with whom they have traditionally been comparable. Empirically, it is hard to distinguish correlated wage increases that are due to comparative wage justice from normal substitution in labour supply between wages for 'jobs' in the same occupation. If a rise in wage rates for electricians in the building industry closely follows those for electricians employed in utilities, we cannot disentangle the economic role of substitution between industries from the role of comparisons in determining workers' desired wage. However, the evidence can be stronger and easier to interpret in some cases. For example, if we observe the wages of office workers in the building industry to follow those for electricians in the same industry, then it will be easier to argue that we have a case of flow-on wage increments through comparisons rather than a case of economic substitution in the production process between office workers and electricians.

The extent to which workers are able to obtain this desired wage through the bargaining process depends on how able or willing employers are to concede to these demands. This balance of power, or willingness to concede, is in turn affected by the presence of labour shortages, the extent of industry profitability, the influence of trade unions or other organised groups and possibly wage-setting institutions. When there are shortages of particular types of labour or the firm has a considerable capacity to pay, then it is not in employers' economic interest to enter into prolonged negotiations for a small wage increase. Similarly, when a high proportion of workers belong to a union, or workers are more organised in other ways, then the ability of workers to inflict losses upon employers is greater.

The tilt of power in bargaining situations, for or against workers, has no necessary alignment with economic efficiency. A wage where workers' power is poor may produce a below market clearing wage. Alternatively, a wage where workers' power is great may produce a wage in excess of market clearing.

Wage flow-on however has no economic function. A rise in wages designed to alleviate a shortage of science teachers that flows on to English teachers, who are not in short supply, creates wage inflation. One test for whether wages are performing efficiently is whether persistent shortages are reduced. If wages respond flexibly to attract and retain qualified workers in their occupation, then persistent shortages should only remain when attrition of skilled people from the occupation is very high and there are impediments to expanding the number of education and training places.

This research takes a primarily empirical and policy oriented view regarding the underlying reasons for the observed disequilibrium in wages and skills. First, it acknowledges that, in principle, many underlying economic reasons can be responsible for observed wages and skills imbalances. Second, it concedes that, given the data limitations in this study, distinguishing between and apportioning the level of impact of different economic causes of wage and skill imbalances may be empirically very difficult if not impossible. Third, this research points towards the fact that the method of estimation used here is general enough to encompass the workings of several underlying economic processes, in that it models a process that is in some form of permanently converging disequilibrium, without needing to specify in exactly what way convergence is to take place and simply concentrating on the speed of convergence and the impact of convergence on different wages by occupation and industry. By assuming such a general and widely encompassing econometric framework, we are shifting the burden of choice of theoretical background to the way that empirical results are interpreted rather than obtained. Finally, this research concentrates on the empirical relationships that the available data are best suited for estimating, namely the inter-relationship between wages within shortage occupations and industries, and wages in their surrounding occupations and or industries.

3. The model

3.1. Choice of estimation method

The purpose of this section is to describe the econometric methodologies that were used in this research. The first part provides an intuitive outline of the econometric methodology. It is meant for the non-technical reader and explains the practical reasons behind the choice of model for the estimations in this research. It concentrates on the way in which data limitations have determined to a large degree the estimation methods used. After reading the first part of this section, the non-technical reader is advised to skip parts two and three, without loss of understanding of the economic policy issues, as these two parts concentrate on the technical aspects of estimation. The second part provides a generic description of the econometric model utilised in the research. The third part adapts the estimation to the specific issues and data at hand and writes out explicitly the model that is estimated later on.

Economics is not an experimental science, hence research has to rely on whatever data is available. It is often that the econometric framework researchers would like to use differs considerably from the econometric framework that they actually use, principally due to limitations of the data at hand. Ideally, one would want a linked employer-employee panel data set with information on individual wages and hours worked accompanied by a number of variables specific to the individual worker, the individual employer, the job match and non-pecuniary job attributes as well as the surrounding macroeconomic conditions. Panel data would be very informative in this context as it would combine information on how an economic agent responds to changes over time (e.g. how the work hours supplied may respond to a changed job attribute) and differences between individuals at a given point in time (e.g. how at any given point in time different employees in different jobs work for a different number of hours). Given such data, the appropriate method of analysis would have been a Fixed Effects (FE) model using the Generalised Method of Moments (GMM) estimation method. It was clear from the

inception of this research that the availability of appropriate data would be the principal barrier for the development of this research. This method allows for the study of dynamics (change over time) after any unobserved heterogeneity between individual economic agents has been controlled for. Given that individual linked employer-employee data is not available in Australia, this research brought together several existing sources of data and produced a combined data set for estimation. Although the data is described in detail in the data section, it will be useful to explain here its structure and how this relates to the estimation method used for this research.

In the absence of individual linked data over time, a level of aggregation was introduced in order to allow the tracing over time (not of individual economic agents, but) of groups of economic agents. Where this type of aggregation is done in a meaningful way, panel econometric methods can be used. In the present context, aggregation was carried out at the industry and occupation levels. Existing data was sufficiently detailed for most of the variables to be aggregated in this manner. The intuition of this data generation route is that it allows for meaningful comparisons over time between groups of individuals (within specific occupations and industries). The natural econometric modelling route was then to employ a FE model and GMM estimation. The results obtained using FE/GMM estimation were unable to trace any dynamic structure in the process and lacked stability. Although we cannot know this with certainty, we put forward two possible causes. First, FE/GMM in the present application relies on the proposition that past dependent variable values (in levels) can approximate sufficiently well the changes in the dependent variable (in differences). It is possible that the underlying data generating process is one that simply does not support this proposition. In this case, using GMM would be an inappropriate estimation method. Second, FE/GMM by its nature imposes no bounds to estimates. This kind of estimation is statistically demanding as it imposes a very high burden of proof on the data, which means that estimates will be less precise and that it is more likely that estimation results will fail to trace evidence of relationships even in cases where they may be present in the data but not with sufficient strength. The technical reader can refer to Bound et al (1995) who show that GMM-type

estimators perform poorly if the data provides only weak information. Blundell and Bond (1998) draw similar conclusions for GMM estimation of dynamic panel data models. However, in some cases, this modelling route may not only be unavoidable, but may be the only route that makes economic sense. E.g. if we wish to estimate the overall impact on labour supply of a new policy which may increase labour supply for some employees and decrease it for others, we have to leave the estimates unbounded. In cases like that, the estimation method requires strong information in order to produce conclusive results.

By contrast, where there may be sufficient *a priori* economic reasons to justify making some restricting assumption about the workings of the process we wish to estimate, the burden of proof that is imposed on the data can be reduced substantially. This is the route that is followed in this research with the modelling of the wage determination process using a partial adjustment (PA) model. Intuitively put, the PA model writes the wage determination process as an adjustment of wages over time and estimates the speed of adjustment. Crucially for the understanding of what this model can do in the presence of possibly weak data is its difference from the FE/GMM model. Both models start with the assumption that a shock will change wages over time. The GMM model tries to estimate simultaneously the direction and the level of adjustment that takes place. The PA model does not try to find the direction of the change, it just assumes that wages will converge towards a new (unobserved) equilibrium and estimates the speed of adjustment. The PA model is thus less demanding from the data. It is useful to note that, indirectly, the PA model provides some limited information about the direction of adjustment. If it finds that the speed of adjustment tends to infinity, then one can presume that there is no support for the hypothesis that there is a converging equilibrium. Although this is a simplified version of the differences in these two fairly complex estimation procedures, it is hoped that it will enable the non-technical reader to understand the intuitive appeal of the estimation methods employed for this research.

3.2. The Partial Adjustment model

One way to understand the general structure of the PA model is by starting with the conventional static human capital equation which stipulates that individual wages are determined by individual characteristics and other observable factors. The relationship can be written as

(1) $$w_i = \beta_0 + \beta_1 x_i + u_i$$

where $\boldsymbol{w}$ and $\boldsymbol{x}$ are observed covariates for a sample of $i=1,2,3,\ldots,n$ individuals, β_0 and β_1 are parameters to be estimated and u is an error term. Equation 1 can be estimated in order to study the associations between levels of $\boldsymbol{w}$ and covariates $\boldsymbol{x}$ reflecting personal characteristics, employment circumstances, environmental circumstances and other pertinent variables. The implicit assumption here is that when we examine a static model we are observing a market equilibrium position where employees are paid a wage $\boldsymbol{w}$ and where observed associations reflect the contribution of each of the observed characteristics $\boldsymbol{x}$ towards the market wage. In order to understand the way in which wages and skills imbalances may arise and persist, the dynamics of wages have to be modelled by introducing the lagged values of wages in the right hand side of Equation 1

(2) $$w_{t,i} = \beta_0 + \beta_1 x_{t,i} + \beta_2 w_{t-1,i} + u_{t,i}$$

where t denotes time and past values of $\boldsymbol{w}$ are allowed to influence the present values of $\boldsymbol{w}$. The adjustment process of present and past wages could be viewed as follows. Individuals have a long-run level of wage which reflects their personal characteristics and their environment, including all institutions associated with wage setting. If one assumes that markets are perfect and that there are no external shocks, present observed wages and past observed wages should both equal the marginal product value of labour (the product of each employee expressed in monetary terms) and labour markets would clear. However, if one makes the more realistic assumption that market imperfections may be present and that external shocks do happen, then individuals' wages will be removed from their optimal position and every external shock will give rise to efforts to relocate

towards their new optimal position. The speed of the wage adjustment process will depend on many factors which influence the well documented stickiness of wages in the labour market, such as institutional factors, information asymmetries and other. In order to study the speed of adjustment empirically we start with writing

(3) $$w_t - w_{t-1} = \delta(w_t^* - w_{t-1})$$

where $0 \le \delta \le 1$ denotes the speed of adjustment and $\boldsymbol{w}^*$ is the (unobserved) desired wage level. Partial adjustment models have gained their name in the literature because they portray a situation where any expected adjustment to the new level may not be feasible in the short run. When an individual is taken away from their present level of $\boldsymbol{w}$, it may take them several periods to relocate to a new level. Indeed, in the context of bargaining for wages, a continual reality in the labour market, the new level may never be observed, as new circumstances often arise in the form of external shocks and/or new rounds of negotiations. In the context of searching for a new job the new wage level may be the reflection of the wage distribution which is never observed fully by a job searching person. It is useful in this context to retain generality and treat $\boldsymbol{w}^*$ as an unobserved value that will have to be estimated explicitly or implicitly. Let us write the unobserved wage level $\boldsymbol{w}^*$ as

(4) $$w_t^* = \beta_0 + \beta_1 x_t^* + u_t$$

in order to reflect the lack of precise information on w^*. This could reflect, for example, the *ex ante* indeterminacy of a bargaining or of a job search outcome.

At the population level, the mechanism of adjustment could be described and estimated as follows. In each period a proportion λ of the distance between actual and desired wages (w-w^*) is covered. The extreme case of $\lambda = 1$ (where w_{t-1} vanishes from Equation 3) reflects the case where $w_t = w_t^*$ and the process becomes a static one, in the sense that adjustment is *complete* and *instantaneous* and the dynamic properties of the process are

of little empirical interest and/or consequence. In the context of the present study, $w_t = w_t^*$ would represent a labour market with no wage stickiness at all, where everybody finds themselves in their desired wage level and information asymmetries and/or institutional issues do not have an impact on labour market outcomes. Clearly, there is little empirical evidence to support the presence of perfect and/or instantaneous adjustments in the labour market and, therefore, little interest in studying them. The other extreme case of $\lambda = 0$ (where w_t^* vanishes from Equation 3) reflects the case where $w_t = w_{t-1}$ because changes in w_t^* do not have any impact on w itself, which stays unaltered even after external shocks may have taken place, or in spite of bargaining changes having occurred. Again, there is little empirical evidence to suggest the total lack of adaptive reactions in the labour market.

Values of λ that are between 0 and 1 are empirically pertinent. The closer to 1 (0), the larger (smaller) the labour market imbalances and the faster (slower) the adjustment of the process at hand. The remaining estimation problem in this context is that w_t^* is unobservable and has to be solved out of Equation 3. By rearranging Equation 3 so that w_t becomes the left hand side (dependent) variable, and rewriting Equation 4 with w_t^* a function of observed $\boldsymbol{x}$ (along the lines of Equation 1) one ends up with an expression which consists only of observable magnitudes

$$w_{t,i} = \lambda\beta_0 + \lambda\beta_1 x_{t,i} + (1-\lambda) w_{t-1,i} + u_{t,i} \tag{5}$$

Equation 5 can be re-written and then estimated in the form of

$$w_{t,i} = \gamma_0 + \gamma_1 x_{t,i} + \gamma_2 w_{t-1,i} + u_{t,i} \; . \tag{6}$$

After estimation, $\hat{\lambda} = 1 - \hat{\gamma}_2$ can be calculated and the original estimates $\hat{\beta}_0 = \hat{\gamma}_0 / \hat{\lambda}$ and $\hat{\beta}_1 = \hat{\gamma}_1 / \hat{\lambda}$ can be retrieved. The interpretation of $\hat{\gamma}_2 = (1 - \hat{\lambda})$ once it has been estimated

is as follows. The closer the value of $(1-\hat{\lambda})$ is to zero, the closer the value of $\hat{\lambda}$ is to one, and the faster the adjustment process towards unobserved *w** defined in Equation 3. For $\hat{\lambda}$ values close to one, estimated dynamic adjustment is almost instantaneous and there is no obvious dynamic interpretation of the data, apart from the suggestion that shocks appear to be absorbed almost immediately.

3.3. Econometric Specification

The context in which skill shortages are analysed in this study is that of occupations and industries. The subscripts used in the Section 5.1 where the general form of the PA model was presented will have to be complicated now. In order to specify the unobserved desired wage ***w**** we assume that the nominal wage desired by employees in period *t* for each occupation (denoted by subscript *occ*), and industry (denoted by subscript *ind*), depends on both comparison with peer workers, and customary real income levels. Own wages are compared with two peer groups, first with those in the same occupation but all other industries and second, with those in all other occupations in one's own industry. This general statement can be written as

$$(7) \qquad w^{*}_{oi,t} = f\left(w^{e}_{flow-on,t}, w^{e}_{outside,t}, p^{e}_{z,t}, Z_{oi,t}\right)$$

where p_z are the prices of imports and the superscript e is used to indicate expected levels. The idea here is that we wish to model the possibility that desired wages in one's own occupation (denoted by the *o* subscript) and own industry (denoted by the *i* subscript), $w^{*}_{oi,t}$, may be influenced by both expected *Flow-on wages* (that is, $w^{e}_{flow-on,t}$, the wages in the same industry but other occupations), and expected *Outside wages* (that is, $w^{e}_{outside,t}$, the wages in the same occupation but other industries). We

also model the possibility that there may be real-wage resistance in the economy (in that the desired wage may also be formed by the expected rise in the cost of living). Insofar as this differs from the wage rises received by other workers (both Flow-on wages and Outside wages), this includes the prices of imported goods (p_z).[4] Finally, a set of control variables *Z*, is included in the specification. Note that this general formulation allows for the possibility that the relationships to be estimated may be of a non-linear nature.

In what follows, we represent expectational variables by the lagged value of the variable itself. This is consistent with the view that when it is not possible to make future predictions based on mathematical calculation, rational agents will (on average) rely on conventions. A common convention is to assume that present circumstances will continue into the future, not because they believe this is probable, but because there is no reason, on balance, why it should change in one direction and not another. This is tantamount to assuming that estimates of the future states of the world are much more strongly influenced by the present and past states (which are known with certainty) rather than by available speculative forecasts (which may be viewed with little confidence). The use of lagged variables as explanatory variables also helps in alleviating possible estimation problems which are caused by endogeneity bias.[5]

As explained in the data section, the degree of detail in the available data differed by the source of the data itself. Information on some factors was only available at an aggregate level, whilst on other factors it was available at a much more detailed microeconomic level. We have used aggregated variables to estimate the possible effect of real-wage resistance. In effect this amounts to treating all employees as homogenous in this context. By contrast, the variables to represent comparative wage justice are microeconomic and have been designed to relate specifically to the wage rate for each occupation and

[4] I.e. including the domestic consumer price index would involve some double counting with the two peer wage variables. Note that these variables may contribute towards holding down wage inflation just as much as they may propel inflation.

[5] Ideally, the validity of this assumption should be tested. However, for our data the shortness of the time series precludes such testing.

industry cell. It should also be noted that the wage and price data are by their nature co-integrated. In order to avoid any resulting problems we defined the desired wage in first-difference terms to recast them as I(0) variables. Thus we end up with the following linear specification for *w**

$$(8) \qquad w^{*d}_{oi,t} = \beta_1 w^{d}_{flow-on,t-1} + \beta_2 w^{d}_{outside,t-1} + \beta_3 pz^{d}_{t-1} + \beta_4 Z_{oi,t}$$

where superscript *d* stands for the difference between period *t* and *t-1* and periods *t-1* and *t-2*. , and subscript *oi* for a job as defined by the two digit occupation and one digit industry. The next step is to specify the partial adjustment coefficient λ .

At this stage the PA model framework can be introduced in the modelling of wage determination by substituting Equation 8 into Equation 3

$$(9) \qquad w^{d}_{oi,t} = \lambda_{i,t}\left(w^{*}_{oi,t} - w_{oi,t-1}\right)$$

where $\lambda_{i,t}$ is the adjustment coefficient to be estimated within the PA model that reflects the degree to which wages respond to economic and other factors and which potentially varies according to both occupation and industry. The next step is to introduce explicitly the factors that may be associated with the speed of adjustment $\lambda_{i,t}$ by writing

$$(10) \qquad \lambda_{i,t} = \alpha_1 Shortage_{o,t-1} + \alpha_2 \pi_{i,t-1} + \alpha_3 U_{oi,t} + \alpha_4 EBA_{i,t-1}$$

where four factors are modelled to influence the speed of adjustment, $\lambda_{i,t}$,directly:

Box 2

MODELLING THE SPEED OF ADJUSTMENT

The level of excess demand for an occupation, *shortage* is represented in the empirical specification of the model by the Skills in Demand indicators. It is equal to 1 if the occupation has been classified as being in shortage and 0 otherwise.

A measure of profits per employee by industry, π, (1-digit level) to reflect the ability of firms to award pay rises and the costs – profits foregone – of entering into an industrial dispute

The extent of organised worker power is represented by a measure of union density in each occupation-industry 'job', *u*.

The proportion of employees who work under an Enterprise Bargaining Agreement in each industry, *EBA*.

It is worth noting that, with the exception of trade union density (the effect of which is largely contemporaneous in negotiations) all factors associated with the speed of adjustment have been lagged. This serves two purposes. First, it ameliorates any concerns regarding endogeneity in their influence on wages.[6] Second, it makes economic sense and allows for a more intuitive interpretation of results. To adjust for change to the age, sex and casual composition of each occupation-industry group, the average age, sex and casual employment density of individuals in each group have also been included as explanatory variables in the estimation.

[6] It is not claimed here that endogeneity is treated in the way that a fully developed fixed effects GMM model would do. This is simply not feasible with the data at hand. What lagging does here is to remove some of the potential impact of endogeneity bias from the estimates. It is not feasible in this context to establish how much this is the case in the present estimations, but it is a well established econometric result that, in principle, this step helps with endogeneity correction where this may be present.

Combining Equations 8, 9 and 10 and taking first differences to eliminate fixed effects yields the final specification (Equation 11) which is estimated using non-linear least squares

$$
\begin{aligned}
& w^{d}_{oi,t} = \\
& \left(\begin{array}{l} \alpha_1 Shortage_{\ o,t-1} + \alpha_2 \pi_{i,t-1} + \\ \alpha_3 U_{oi,t} + \alpha_4 EBA_{\ i,t-1} \end{array} \right) \times \\
& \left(\begin{array}{l} \beta_1 w^{d}_{flow-on,t-1} + \beta_2 w^{d}_{outside\ ,t-1} \\ + \beta_3 pz^{\ d}_{t-1} + \beta_4 Z_{oi,t} \end{array} \right) + \\
& \left(\begin{array}{l} 1 - (\alpha_1 Shortage_{\ o,t-1} + \alpha_2 \pi_{i,t-1} \\ + \alpha_3 U_{oi,t} + \alpha_4 EBA_{\ i,t-1}) \end{array} \right) \times w^{d}_{oi,t-1}
\end{aligned}
\qquad (11)
$$

STATA 9.2SE procedure *nl* (for non-linear estimation) was used for all estimations.

4. The data

To estimate (11), we specifically require data that is disaggregated by occupation and industry. [7] For this purpose we have specifically constructed a panel data set of hourly wages, and their related characteristics for several hundred 'jobs' as defined by a 2-digit occupation and 1-digit industry cell. These wage variables has been formed from 15 cross-sectional surveys of employees in Australia from 1989 to 2005 excluding 1991 and 1996 when the relevant data was not collected.[8] Data for 1991 and 1996 have been estimated as the average of each variable a year before and a year after the missing

[7] An idea data set would be a linked employee-employer panel dataset which includes employee-level variables (wages, hours of work, the pecuniary value of other work-related benefits/costs, age, sex, work experience and qualifications of the person, the location of the job), labour market-level variables (whether there are shortages or surpluses for the employees skills and the extent thereof); employer-level variables (profits, sales, capital stock) and macroeconomic variables. This data set would also need to extend to all occupations and industries in a fashion which would prevent selection bias from contaminating estimation results.

[8] ABS Employee Earnings, Benefits and Trade Union Membership, Australia, cat 6310.0. August various years. Earnings could not be determined for owner managers working in their own limited liability company who did not draw a wage or salary and prior to 2004 they appear to have been excluded from the dataset. In 2004 and 2005, their wage was extrapolated from other records based on the age, sex, location, occupation, hours and whether worked full- or part-time.

observation. 44 2-digit ASCO2 occupations and 32 1 or 2-digit ANZSIC industry groups were used.[9] We excluded cells with less than 10 observations, which left us with between 243 and 308 in each year. The wage for each cell is the mean-hourly wage for all observations in that cell. It only includes the wages of full-time workers in their main job.[10] Flow-on wages are calculated as average wage levels in the same industry but other occupations, and outside wages are wages in the same occupation but other industries. Data on the average age, sex, trade union density and the rate of casual employment status for each 'job' has also been calculated.

To this dataset we have linked in annual occupational information of labour market shortages, annual industry information on profits per employee, and the annual price of imports index. Detailed data on labour shortages by occupation and industry is not available. While ideally, we would like to use vacancy duration data for each 2-digit occupation in each 1-digit industry, all we have available are the Skills-in-Demand binary indicators[11] which are an amalgam of information from telephone surveys and vacancy data.[12] Managerial and semi- and unskilled occupations, with the exception of childcare workers, are not included in these assessments. Similarly, we are not able to estimate profits per worker by occupation, nor the actual import price index facing each type of worker.

[9] In cases where an occupation was heavily concentrated into one 1-digit industry (such as school teachers in education), we used a 2-digit industry disaggregation.

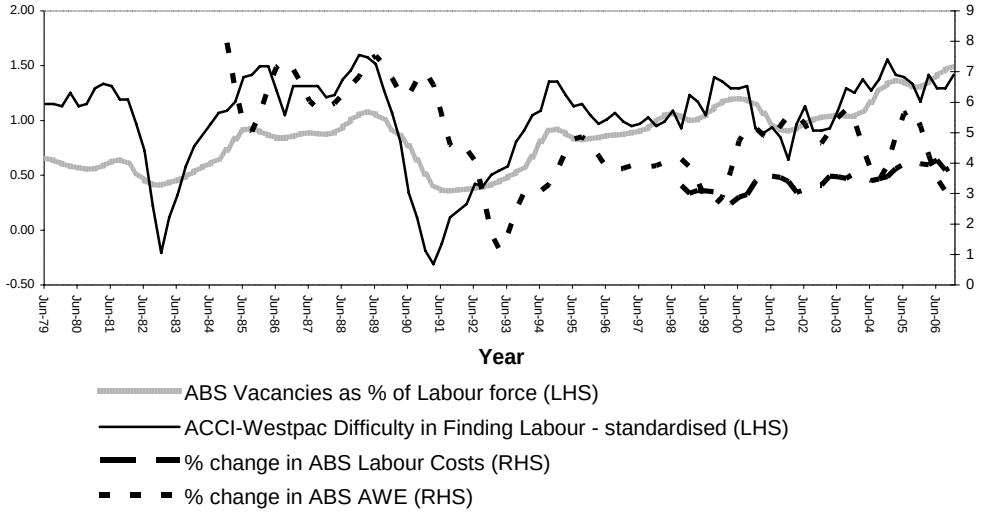
[10] See Australian Bureau of Statistics 'Employee Earnings, Benefits and Trade Union Membership', cat. 6310.0, various years for further definition and sample selection.

[11] A binary indicator is a simple 0-1 variable. It is 1 if a shortage is deemed to exist and 0 otherwise. It does not quantify the magnitude of the shortage. This data is collated by DEWR.

[12] To determine an occupation's shortage status, DEWR staff contact employers who have recently advertised vacancies in the occupations included in the skills in demand research programme. Vacancies are collected from available sources, including major metropolitan and regional newspapers, general employment and specialist industry/occupational Internet sites as well as professional associations. Where there are sufficient vacancy numbers, vacancies for follow-up are randomly selected. For some occupations, adequate numbers of vacancies are not identified, and in these cases all vacancies found with appropriate contact information in the survey period are followed up and other employers are cold canvassed to ensure assessments are based on a sufficient number and range of contacts. The minimum information sought from employers is the number of vacancies, whether vacancies were filled, the total number of applicants, and the number of suitable applicants. However, supplementary information is collected where practical, through the standard questionnaire. The research aims to collect information about why vacancies are unfilled as this is important for making a decision about the rating for each occupation.

The first thing we note is the state of the labour market since the early 1980s which is represented by a demand for labour series, a labour shortage series, and two annual wage increments series in Figure 1. According to both the ABS vacancy series and the ACCI-Westpac Difficulty of Finding Labour series, the aggregate labour market has almost continually tightened since the early 1990s when Australia was in a serious recession. Until the mid-1990s, there was a reasonably strong positive correlation between the degree of labour market tightness and overall annual wage increases. Since the mid 1990s, annual increases in Average Weekly Earnings (AWE) have remained in the 3 to 6 per cent band using the ABS AWE series, in an environment where the aggregate labour market has continued to tighten. The AWE series is much more volatile than the wage costs measured by data from the ABS Labour Price Index (ABS Cat. No. 6345.0, Wage Price Index, http://www.abs.gov.au/ausstats/abs@.nsf/mf/6345.0/) where annual growth in employee wage costs ranged between 3 and 4 per cent between 1998 and 2006. The Wage Price Index has been the preferred measure of wage costs. It is used to measure changes in wage and salary costs of a representative 'basket of jobs' over time, as it is less affected by changes in the quality and quantity of work performed.

Figure 1: Indicators of skill shortages and wage inflation



Tables 1 and 2 present a summary of the data used in our estimations. The first two columns of Table 1 give the percentage distribution by occupation of our sample and the ABS population estimates (for the period August 1996 to August 2006). This indicates that the data we use slightly under sampled professionals and clerical and service workers in favour of tradespersons. The next two columns show which occupations have had at least one spell of shortages that lasted for 5 years and those occupations where the shortages are intermittent (spells under 5 years) as suggested by the Skills-in-Demand indicator. The table shows that some occupations have experienced both persistent and intermittent skill shortages over the 16 year period.

Table 1 shows (in Columns 3 and 4) that the occupation groups which have experienced spells of persistent skill shortages include health and education professionals and tradespeople. The final column presents the annual change in hourly wages (in dollars) for each occupation. While there was an overall annual rise in hourly wages of 3.03 per cent, of most interest to us is that the rise for occupations in persistent shortage was less than the average (at 2.28 per cent), while the wage rise for occupations in intermittent shortage was above the average (at 3.37 per cent).[13] On the assumption that skill shortage indicators reflect real skill shortages, this finding may be used to suggest that a lack of wage responsiveness to excess demand may be contributing to the persistence of labour shortages in some occupations. Whilst it could be argued that in the case of intermittent skill shortages observed wage rises may be subjected to time lags, this argument would be hard to sustain in the case of persistent skill shortages. Indeed, persistent skill shortages are a puzzling observation in labour markets where training and up- or re-skilling is feasible. Our later analysis goes some way towards explaining this rather counter-intuitive observation. To start with, note that Table 1 presents raw (unconditional) statistics, which do not take into account any differences in the composition of the labour force by occupation, industry and, indeed any other pertinent factor that may influence the responsiveness of wages to excess demand. This can only be done using multivariate regression which generates (conditional) statistics.

[13] Note that the averages have used number of employees weights.

Table 1: Occupational distribution of estimation sample, 1989 to 2005

Occupation (2-digit ASCOv2)	*Sample – average 1989-2005 (percentage distribution)*	*Population - average 1996-2006[a] (percentage distribution)*	*Presence of persistent shortage[b] spells during 1989-2005*	*Presence of intermittent shortage[b] spells during 1989-2005*	*Average annual change in wages 1989-2005(%)*
Managers	8.53	6.03			
Generalist Managers	2.23	1.39			2.79
Specialist Managers	6.30	3.94			3.21
Professionals	14.24	19.16			
Science, Building and Engineering Professionals	3.95	2.16		x	2.67
Business and Information Professionals	6.26	5.69		x	3.61
Health Professionals	0.31	3.60	x		3.75
Education Professionals	0.27	4.78	x		2.31
Social, Arts and Miscellaneous Professionals	3.45	2.90		x	2.81
Associate Professionals	12.82	11.14			
Science, Engineering and Related Associate Professionals	3.80	1.56			2.90
Business and Administration Associate Professionals	3.84	3.94			3.13
Managing Supervisors (Sales and Service)	4.26	3.76			3.34
Health and Welfare Associate Professionals	0.54	0.75		x	3.27
Other Associate Professionals	0.38	1.13			2.27
Tradespersons	16.19	11.58			
Mechanical and Fabrication Engineering Tradespersons	3.45	2.38	x	x	3.31
Automotive Tradespersons	1.65	1.40	x	x	3.20
Electrical and Electronics Tradesperson	3.88	1.96	x	x	3.27
Construction Tradespersons	0.84	2.11		x	4.63
Food Tradespersons	1.42	0.99	x	x	1.43
Skilled Agricultural and Horticultural Tradespersons	1.73	0.69			2.37
Other Tradespersons and Related Workers	3.22	2.04	x		2.04
Advanced clerical and service workers	8.29	4.11			
Secretaries and Personal Assistants	4.30	2.31			3.06
Other Advanced Clerical and Service Workers	3.99	1.81			3.57
Intermediate Clerical, Sales and Service Workers	11.63	18.55			
Intermediate Clerical Workers	7.41	10.64			3.74
Intermediate Sales and Related Workers	1.65	1.75			3.61
Intermediate Service Workers	2.57	6.17		x	2.69
Intermediate Production and Transport Workers	7.68	8.79			
Intermediate Plant Operators	3.30	2.17			2.92
Intermediate Machine Operators	0.31	1.02			3.04

Road and Rail Transport Drivers	3.99	2.82	3.04
Other Intermediate Production and Transport Workers	3.38	2.76	3.06
Elementary Clerical, Sales and Service Workers	7.37	11.00	
Elementary Clerks	2.00	0.91	2.90
Elementary Sales Workers	3.45	8.78	2.83
Elementary Service Workers	1.92	1.31	3.11
Labourers and Related Workers	9.94	9.65	
Cleaners	2.61	2.26	2.43
Factory Labourers	1.46	2.75	1.14
Other Labourers and Related	5.87	4.61	2.74
Total	100.00	100.00	3.03
Average wages (persistent shortages)			2.28
Average wages (intermittent shortages)			3.37

Notes: [a] Employees only. ABS data cube E07_Aug96, [b] Skills-in-Demand, DEWR. A persistent shortage spell is recorded when the occupation has had at least one spell of continuous shortage for over 5 year. An intermittent shortage spell is recorded when the occupation has had at least one spell of shortage lasting less than 5 years. Where both types of shortages have been observed during the time frame, both boxes are ticked. Averages are weighted by number of employees.
Wage data in the right hand column is sourced from unpublished ABS Employee Earnings Benefits and Trade Union Membership data (Cat. No. 6310.0)

As our multivariate results presented below show that, once we include the potential effect of surrounding factors in our calculations, the data does not support the proposition that wages are non-responsive to skill shortages.[14]

Table 2 presents annual average changes for wages, the import price index and profits per employees and the level of employees working under an enterprise bargaining agreement relative to the mean for the whole period (lagged one year). The wage rate and import price index variables are year-on-year changes and are thus stationary variables. While the annual change in wages have been reasonably smooth, there have been marked variations in change in import prices. Profits per employee relative to wages are, by construction, a stationary variable, and the rise between 1996 and 2005 no doubt reflects the overall strength of the macro economy during this period. The main variable used in

[14] Regression below uses fixed effects estimation which controls for both observed and unobserved time invariant characteristics. Once this is done, it becomes clear that wages are responsive to skill shortages. Simply put, the reason why there appears to be no relationship when we look at the raw data is that the factors that are controlled by multivariate regression must be counteracting each other in a way that conceals the true relationship between wages and skill shortages. For an overview see Box 4 below.

this study to denote the influence of enterprise bargaining on wages is the sum of all employees working under a certified Federal enterprise agreement divided by total employees (by 1-digit industry). While we have no comparative measure for State jurisdictions, according to Hawke and Wooden (1998), and Wooden (2001), there was a parallel take up in State jurisdictions as well. Nonetheless, the Federal data, presented in the last column (of employees working under an enterprise agreement as a percentage of all employment) reveal a strong and continuing trend between 1991, when the data collation began, and the mid-1990s.

Table 2: Regression descriptive statistics – 1991 to 2005

Year	*Average change in wages ($)*	*Change in import price index (lagged)*	*Profit per worker/wages (lagged)*	*Employees under an enterprise bargain per 1000000 employees (lagged)*
1991	0.50	4.68	1.59	0.1000
1992	0.55	3.15	1.60	0.1082
1993	0.82	-0.47	1.64	0.1580
1994	0.07	9.38	1.71	0.1997
1995	0.38	3.50	1.74	0.2008
1996	0.88	-0.78	1.54	0.2162
1997	1.05	0.22	1.54	0.1763
1998	-0.14	-6.45	1.53	0.1855
1999	0.82	6.80	1.59	0.1934
2000	0.16	4.55	1.61	0.1913
2001	1.05	0.32	1.67	0.1898
2002	1.32	14.03	1.70	0.2079
2003	0.80	-1.95	1.82	0.2036
2004	0.50	-6.35	1.80	0.1835
2005	1.43	-13.70	1.86	0.1967
Total	**0.68**	**1.32**	**1.66**	**0.1497**

5. Estimation results

Before discussing the regression results, we mention a few limitations of the analysis and how serious they are for our findings. In order to put the estimation method and results in the right context it is worth remembering the main objective of this study is “to estimate

the effects of workplace reform on wage inflation in Australia, while controlling for other potential causes for wage pressures, such as the price of imports, labour shortages and other".

Almost all our measures, of both the dependent variable (hourly wage rates) and the explanatory variables (the shortage indicator variable, union density, flow-on wages, outside wages, price of imports in workers consumption bundle, age, sex and casual status of occupation) are proxy variables for what data we would use in an ideal setting. Ideally we would want (i) total labour costs, including non-pecuniary benefits as well as the value of superannuation contribution, as the dependent variable, not wages; (ii) labour costs for the actual flow-on occupations not the ones we have second guessed for this paper;[15] (iii) detailed evidence on the extent of shortage or surplus for the specific job – not a single binary indictor for a 2-digit occupation group. However, to the extent that the data at hand mimics the substantial underlying economic factors, we should get a significant and correctly signed coefficient in the regression estimations.[16] That is, if there are strong underlying fundamental forces in the wage setting system that cause wages to rise most when occupations are in shortage, then we should get a positive and statistically significant coefficient for the 'shortage' variable, even though the underlying variable measures shortages imperfectly. So long as the measured variable has reasonable information content, then it will pick up a real relation. As noted above in Table 1 data is not collated on shortages in managerial and semi- and unskilled occupations. One way to accommodate this lack of data is to define a dummy variable '*Missing shortage data*' which takes the value one where there is not information on shortages at all, and is zero otherwise. However, since we want to distinguish the absence of information from genuine absence of a shortage, we only set the 'Missing shortage data" variable to one for the three managerial occupations. That is, we assume that except for Intermediate Service Workers, there are no real shortages of the semi- and unskilled 2-digit occupations.

[15] To the extent non-pecuniary benefits are growing by are correlated with wages, then we will have underestimated the coefficients in the model, but if these benefits are correlated with our explanatory variables, we will have biased results.

[16] The February 2007 St George-ACCI Business Expectations Survey actually reveal that across its surveyed members non-wage labour costs have moved in tandem with wages since 1994 (ACCI 2007).

5.1. Overview of variables

Before we present estimation results the variables in the empirical model are summed up in Box 3 using the names under which they appear in the Tables containing estimation results. Note that estimation produces the coefficients presented in Equation 11. These coefficients are then summed in order to generate the overall associations presented in the results below. Non-technical readers should interpret the coefficients in the following way.

The dependent variable (see Box 3) is a measure of wage changes in an occupation/industry data cell. Estimation shows how the independent variables are *jointly* associated with the dependent variable. The type of association revealed by estimation is reflected by the coefficient for each of the independent variables. The sign of the coefficient reveals the direction of the association, the size of the coefficient reveals the strength of the association, and the reported t-ratio reveals the precision of the estimate, with a larger t-ratio revealing a more precise (better) estimate. It is crucial to note that the statistical technique allows for all independent variables to co-vary without this contaminating the results, but does not in itself measure any relationship between the independent variables themselves: it only measures the relationship between the dependent variable and each of the independent variables conditional on the rest of the independent variables.

The implication is that the effect of each independent variable can be distinguished from that of other independent variables. This is crucial for the understanding that the estimates we report on outside wages and flow-on wages allow us to distinguish between the (desirable) outside wages effects from the (undesirable) flow-on wages effects to other occupations in the same industry. While a non-linear model has been used here (see Equation 11), the interpretation of the coefficients is similar to a linear model; that is, positive coefficients imply that an increase in that variable will lead to higher wage rises, *ceteris paribus*.

Box 3

VARIABLES USED IN THE ESTIMATIONS

w_{oi} : is the explained variable (often called the dependent, or left-hand-side variable). This is the average wage in each 2-digit occupation (subscript *o*) and 1-digit industry (subscript *i*) in each year (subscript *t*). The model portrays the way in which over time variation in this variable may be related to over time variation in the remaining "explanatory" variables, and helps formulate testable hypotheses. Estimation is used in order to ascertain the hypotheses that may be supported by the data and those that may not. The explained variable crucially defines the categories to which the explanatory variables belong to.

***Shortage*: Skill shortages in own occupation. This the Skills–in-Demand binary indicator which are an amalgam of information from telephone surveys and vacancy data.**

***EBA*: The number of employees employed under an Enterprise Bargaining Agreement in each 1-digit industry in each year relative to the mean for all years in each industry.**

π: This is an annual measure of the profits per employee for the industry.

***u*: Proportion of employees belonging to a trade union for each occupation and industry.**

***Outside wages*: These are the mean wages paid to everyone in the same occupation group but in all other industries apart from that of the explained variable.**

***Flow-on wages*: These are the mean wages paid to every one within a given industry apart from those in the same occupation.**

p_z : This is an index for the price of imports in each year.

***Age*: The mean age of those employed in the same industry and occupation as the explained variable.**

***Sex*: The proportion of men amongst those employed in the same industry and occupation as the explained variable.**

***Casual*: The proportion of those in casual employment amongst those employed in the same industry and occupation as the explained variable.**

5.2. Estimations looking for a structural break in the mid-1990s

Two separate estimation strategies have been used in order to investigate this question. First, in order to capture the possibility that a structural break occurred in the labour market due to workplace reforms, the data was split in two parts: before and after 1994. Although workplace reform was introduced gradually in the 1990s, the year 1994 saw some major changes and could be thought off as the time when changes started to take effect for good. When we decided to split a sample, it was not clear at exactly what date a threshold point should be placed and it must be acknowledged that defining thresholds always contains a degree of arbitrariness.

On balance it was decided to use the threshold date of the end of 1994, and estimate the same model for the 1991-1994 and the 1995-2005 sub-samples.[17] The idea behind splitting the 1991-2005 observation period in two sub-samples is that if workplace reforms have had a marked effect on labour market outcomes and the relationship between skill shortages and wage determination, one should be able to detect this in the form of different results between the two time periods. Table 3 contains the results from these estimations. The first important observation is that the sample of the 1991-1994 period is much shorter (from 1989 to 1994, contains six years, minus two years due to the lagging of variables leaves a four year long panel) than the post-1994 sample (from 1995 to 2005 contains 11 years, minus two years due to the lagging of variables leaves a nine year long panel). It should therefore be expected that estimation using the shorter 1991-1994 sample will be far less precise than estimation using the longer 1995-2005 sample. With this in mind we turn to Table3.

[17] In order to acknowledge the fact that defining thresholds always contains a degree of arbitrariness, and in order to test the sensitivity of the results presented here to choice of end-1994 as the threshold date, the same model was estimated using the end of 1993 and the end of 1995 as the threshold points. Results were not particularly different, although the end of 1993 threshold sample suffered low precision estimates caused by the limited number of pre-1994 observations.

Table 3: **Mid-1990s structural change. Dep. variable: change in 'job' wage rates**

	1991-1994		*1995-2005*	
Independent variables (lagged as in Equation 11)	*Coefficient*	*t-ratio*	*Coefficient*	*t-ratio*
Shortage	0.256	1.95	0.546**	10.05
Π (profits per employee)	0.081**	3.09	0.108**	12.93
U (Union density)	2.006**	17.08	2.057**	25.00
Missing shortage data	1.074**	9.42	0.834**	16.99
Outside wages (change)	0.066	1.18	-0.001	-0.05
Flow-on wages (change)	0.190**	3.66	0.030	1.34
Import prices (change)	-0.009	-0.72	-0.002	-0.27
Control variables				
Age	0.024**	3.95	0.054**	8.34
Female	-0.216	-1.48	-0.802**	-4.70
Casual	-1.810**	-2.63	-1.821**	-3.43
Observations: Industry × Occupation × Year	922		2074	

Note: Dependent variable is the mean wage by occupation-industry 'job' for each year. The t-ratio is a conventional measure of statistical significance for each estimate. The larger the t-ratio the more precise (and therefore, trustworthy) the estimated association is. For ease of reference, **, * indicates that the coefficient is significant at the 1 and 5 per cent levels respectively.

Table 3 suggests that *Shortages* are associated with higher wages. The larger 1995-2005 coefficient suggests that the association grew stronger after 1994 from 0.256 to 0.546. The rise in the precision of the estimate (reflected in the substantial increase in the 1995-2005 t-ratio, from 1.95 to 10.05) could be because of two reasons. First, the estimated relationship became more precise after 1994. Second, the relationship did not change pre- and post-1994, but the data measuring it has become more precise because of the substantial increase in the sample size (with 2074 1995-2005 observations, against 922 1991-1994). We cannot tell which of the two reasons is the dominant one, but would argue that both play a role in this instance.[18] The variable *Profits per employee*, as a reflection of the ability of the employer to award/afford pay rises, is shown to be positively associated with higher wages in both periods. The presence and density of

[18] A picture of the two possible sources of difference (statistical versus real change) can be made by shown by calculating the 5 percent confidence intervals around the two coefficients and looking at how close their tails get to one another. For 1991-1994 the 0.256 coefficient lies in (0.007 , 0.519). For the 1995-2005 period the 0.546 coefficient lies in (0.437 , 0.655)

Trade Unions is positively associated with higher wages in both periods but the causality direction in this result is not clear.

Outside wages are not significant in either of the two sub-samples. This is an estimate of the degree to which wage increases for a given occupation in one industry can result in wage increases for that same occupation in all other industries. The lack of statistical significance in this result suggests that there is little evidence in this data of a transfer of wage pressures for specific occupations across industries. One way in which this result could arise would be through the segmentation of the turnover process by industry. Further information would be needed for such an exercise.[19]

By contrast, *flow-on wages* have a significant positive association with wages but only for 1991-1994. During 1995-2005, the estimated coefficient was insignificant. Flow-on wages represent wage increases that are copied by other occupations in that same industry. This estimate could arise from labour complementarities within industries. It could also suggest comparative justice-based wage increases in Australian industries. This difference in coefficient size and significance between periods held regardless of whether we split the sample at 1994, 1995 or 1996. One could interpret this result as indirect evidence of the (positive) effect of workplace reform on the 1995-2005 wage inflation. Finally, import prices are found to have no significance in both periods. The message here is that imported inflation is not a crucial determining factor in the determination of Australian wages in the period under investigation and has not contributed to wage increases.

[19] The present data cannot allow the investigation of individual employment trajectories. Longitudinal information on the origins and destinations of different types of individual turnover by occupation and industry would be necessary for disentangling this issue. If not already with the fifth 2005 wave, soon enough, HILDA data should be able to investigate this issue, albeit in a one-sided way as the individual employer information is limited and not of a panel nature.

Finally, the estimation contained three control variables: the mean age of the workforce the proportion of females and the proportion of casual workers in each occupation-industry group. All three produced the expected sign: positive for age, as earnings increase with age; negative for females, reflecting the wage penalty that females face in the labour market; negative for casual workers, reflecting the fact that unadjusted average casual pay is lower than non-casual pay. Furthermore, all three variables are more precisely estimated and they show higher statistical significance for the 1995-2005 period because of the larger sample size.[20]

Box 4 below sums up the main results from the estimations tracing the presence of a structural break.

Box 4

MAIN ESTIMATION RESULTS ON A STRUCTURAL BREAK IN THE MID-1990S

Skill shortages are positively associated with wage increases in the occupation of shortage. There is some weak evidence that this relationship is more pronounced in the post-1994 period.

Outside Wages

Wage increases in one occupation within an industry were not found to influence outside wage increases (same occupation in other industries). This lack of spill overs runs through the whole of the investigation period.

Flow-on Wages

Wage increases in one occupation within an industry appeared to flow-on to wage increases in other occupations within the same industry. However, there is clear evidence that this effect has become weaker over time.

[20] As mentioned in the start of the discussion of Table 5.1 results, the cut-off point at the end of 1994 is a guess as to where one could split the sample in pre-reform and post-reform years. Clearly, the effects of any reform do not happen overnight, but influence the economy in a gradual and continual manner. In order to test the sensitivity of the results on the chosen cut-off date, the same estimations were carried out with 31.12.1996 as the cut-off point. Results were very similar and are reported in the Appendix.

5.3. Introducing EBAs into the estimation

Results in Table 3 have established that the factors governing wages changed during the mid-1990s. The remainder of this section follows a different estimation strategy which allows the use of the full sample within a single regression. Results are presented in Table 4. All years are estimated together and the impact of EBAs is introduced in the regression explicitly as a right hand side variable.

Table 4: Estimating the effect of EBAs

	1. Without EBA		***2. With EBA***		***3. With EBA and interactions***	
Independent variables (lagged)	*Coefficient*	*t-ratio*	*Coefficient*	*t-ratio*	*Coefficient*	*t-ratio*
Shortage	0.510**	10.72	0.497**	10.44	0.785**	11.95
Π (profits per employee)	0.111**	14.78	0.106**	14.08	0.099**	13.19
U (Union density)	1.975**	30.1	1.761**	23.1	1.653**	21.48
Missing shortage data	0.860**	20.03	0.811**	18.45	0.766**	17.47
EBA			0.626**	5.38	1.063**	7.99
EBA*shortage					-1.913**	-6.54
Outside wages	0.005	0.22	0.015	0.66	0.008	0.33
Flow-on wages	0.047*	2.32	0.042*	2.14	-0.009	-0.32
EBA*Flow-on wages					0.195**	2.76
p_z ***(import prices)***	-0.002	-0.40	0.002	0.33	-0.001	-0.11
Controls						
Age	0.046**	9.55	0.046**	9.56	0.044**	9.41
Female	-0.608**	-4.91	-0.578**	-4.69	-0.541**	-4.42
Casual	-1.840**	-4.27	-2.051**	-4.75	-1.955**	-4.56
Observations: Industry*× *Occupation*× *Year	2966		2966		2966	

Note: **, *, † significant at the 1, 5 and 10 per cent level respectively. Dependent variable: change in 'job' wage rates.

The first model in Column 1 of Table 4 is in essence averaging out the results presented in Table 3 for the 1991-1994 and 1995-2005 sub-samples and is used as the benchmark case. Column 2 introduces the EBAs variable for each industry in the right-hand side.

Column 3 keeps the EBA variable in the right-hand side and also introduces its interaction with the shortages and flow-on wages variables. The first message from this set of estimations is that the main qualitative results remain largely unchanged after the inclusion of the EBA variable and the EBA*Shortage and EBA*Flow-on wages interaction variables. Interaction variables allow us to test whether the influence of a factor, such as a shortage, is heightened or dampened when EBAs are also present in that industry. Except for flow-on wages, none of the statistically significant associations in Column 1 lose their significance in Columns 2 and 3. Shortages, profitability and trade union density retain their positive association with wages. Similarly, outside wages and import prices remain statistically insignificant. The remaining control variables also retain their qualitative results, with age being positively associated with wage and gender and casual labour negatively associated.

The positive sign of the EBA coefficient suggests that higher wages and the presence of EBAs are positively associated across industries and over time. It is difficult to claim a causal relationship in this context without any further information about developments at the micro level over time.

Clearly, one could think of a case where higher wages could be the result of an employer offering an EBA agreement which is perceived to be productivity enhancing. In such a case one could envisage employers and employees agreeing on measures that can be expected by both sides to increase productivity, putting these measures down in an agreement alongside with a commensurate pay rise. In such a hypothetical case the causality would run from an agreement having been signed which stipulates the conditions for improving productivity and in anticipation of productivity rises offers higher wages: note that first came the agreement and then followed the productivity (and wages) increases because of the agreement having been signed.

Equally clearly, one could think of a case where an EBA may be offered as the result of higher productivity (and wages) already having occurred. One could envisage employers and employees getting together to agree on the way remuneration and working conditions should be formalized and deciding to put them down in the form of an EBA: note that first came the productivity increases and then followed the agreement. This distinction is both important to make and difficult to establish empirically. In addition, it is likely that occupation/industry 'jobs' that traditionally are more organized and have had greater bargaining power, and thus have been better able to achieve their desired wage, are better placed to negotiate an EBA. Results here cannot distinguish between the two possibilities.[21] The present analysis goes only a little way towards addressing this issue, by way of using lagged values in the estimations. However, the length of the lags and the statistical properties of the assumptions made in order to introduce these lags cannot be ascertained by the present analysis. Without the use of longitudinal data which combines employer and employee information alongside with agreements and shortages indicators, the details of this question will have to remain unanswered.

The EBA*Shortage interaction variable is designed to capture the joint association between wage increases and EBAs and skill shortages, *over and above* the individual association between first, wage rises and skill shortages, and second, wage rises and EBAs. A precise negative association of -1.913 has been estimated. In essence what this association implies is that (other things equal) if we compare the situations where (i) there is a skill shortage but not EBA, (ii) there is an EBA but no skill shortage with the situation where (iii) there are both a skill shortage *and* an EBA, the combined effect of

[21] It can be argued that the most likely way in which wage rises may be determined would be on the basis of promises that are contingent upon productivity rises. For example, Certified Agreements are usually negotiated to cover a two to three year period in the future, with annual pay rises offered during that period being made contingent on achieved productivity rises. We would need more detailed data in order to test this in a statistical way.

the presence of a skill shortage and an EBA is somewhat less than the sum of the two individual effects.[22]

The EBA*flow-on wages interaction variable is designed to capture whether flow-on wage increments are more likely to occur in 'jobs' where EBAs are also present. Our estimated coefficient takes the value of 0.195 and is statistically significant. This finding does not support the argument that EBAs suppress wage inflation. Data from the 1995 AWIRS reveals that EBAs were more prevalent among workplaces that were large and highly unionised, with low levels of casual and female workers but fairly predictable demand for their major product (Wooden 2000, Table 3.3). Box 5 sums up the main results of the estimations including EBA-related variables.

Box 5

EFFECTS OF INCLUDING EBA VARIABLES IN THE ESTIMATIONS

Skill Shortages (without EBAs) are positively associated with wage increases.

EBAs (without skill shortages) are positively associated with wage rises.

Where both EBAs and skill shortages are present, the strength of their overall association with wage rises is less than the sum of the two independent associations.

The association between wage rises and outside wages remains insignificant after the inclusion of EBA-related variables.

Most of the association between wage rises and flow-on wages appears to be explained by industries with a high prevalence of EBAs. That is, people working under an EBA are more likely to receive a flow-on wage increase than those who are not under an EBA, *ceteris paribus*.

[22] It is advisable that the exact size of the estimated coefficients are not over-interpreted. The caveat of using a rather sophisticated model with simple data should be borne in mind and simply note the sign of the interaction variable and the fact that it is statistically significant.

6. Conclusion

This study has addressed the question of why persistent skill shortages in the Australian labour market do not appear to be causing any wage pressures. One of the prime issues to address was the degree to which there is any evidence to link workplace reforms from the early/mid 1990s with changes in the wage determination process. In a well-functioning wages system, wages should respond positively to occupational shortages but should not respond to other wage changes in labour markets that do not share a common supply function.

The study used a combination of data sources to construct a pseudo-panel set of wages rate at the level of occupation and industry between the years 1989 and 2005. An augmented partial adjustment model was used to estimate the associations between wage increases, skill shortages and the presence of EBAs in the Australian labour market. The model used information in a lagged form in order to trace causal links rather than just associations, but it is felt that the data is too limited to be over confident about causalities. Results are therefore presented as associations and the need for better data is flagged as a priority for more accurate further research.

Both skill shortages and EBAs were found to be positively associated with wage rises. Wage rises in a specific occupation and industry 'jobs' were found to flow-on to wages in other occupations within the same industry. Wage rises in a specific occupation and industry group were not found to influence other industries where that occupation may also be found. Trade unions were found to be positively associated with wage rises. In those cases where EBAs were introduced in the absence of skill shortages, wage increases were above the average in the labour market, presumably indicating that EBAs reflect either already achieved or successfully motivated productivity increases. In those cases where EBAs were introduced in the presence of skill shortages, further wage

increases are observed than those that would have been warranted by the skill shortages alone, but in a diminishing manner. In the latter case, EBAs are hampering the clearing of labour markets by artificially dampening wage rises for occupations in demand.

The examination of the results from the 1991-1994 and the 1995-2005 periods indicates that the Australian labour market changed during the mid-1990s. Specifically, the strength of flow-on wage increases, which are one of the more pernicious forms of comparative wage justice, fell over the 1990s. Wage increases are still influencing wages in unrelated labour markets but in a more limited and reduced manner. This implies that the bargaining transmission mechanisms were weaker in the post-1994 era. One could link this result with the labour market institutional changes introduced in the mid-1990s. This would imply that the market works in a sharper manner post-1994.

The association between EBAs, skill shortages and wage rises has been found to be positive. In those cases where EBAs were introduced in the absence of skill shortages, wage increases were above the average in the labour market, presumably indicating that EBAs reflect either already achieved or successfully motivated productivity increases. In those cases where EBAs were introduced in the presence of skill shortages further wage increases are observed than those that would have been warranted by the skill shortages alone, but in a reduced manner. That is, the joint effect of skill shortages and EBAs being present is less than the sum of the effect of either EBAs being present (without skill shortages) or skill shortages being present (without an EBA). One possible explanation for this finding is that EBAs may place an artificial ceiling on wage rises for occupations in shortage thus hampering market clearance through the workings of flow-on wage increases. The overall picture that arises from this study is that, on balance, skill shortages are associated with above average wage increases, but in a benign and useful manner, as a market signal for improving the allocation of human resources in the labour market.

The association between EBAs and flow-on wages was positive which suggests that the forces that encourage enterprises to enter into an EBA also make them more prone to granting flow-on wage rises.

Altogether, our results suggest that while the labour market has changed – for the better – by reducing the degree of wage flow-on post the mid 1990s, but note that this outcome cannot be attributed *directly* to EBAs. Better quality data, preferably employer-employee linked micro-data, will be needed for tracing causal relations with accuracy and for understanding the underlying mechanisms at work.

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