1 Introduction

In this Staff Working Paper, a human capital earnings function and data from the Household, Income and Labour Dynamics in Australia (HILDA) survey are used to estimate the effects of education and health status on wages, which can be used as an indicator of labour productivity. The same model is also used to estimate the potential wages of people who are unemployed or not in the labour force if they were to become employed.

The outline of the paper is as follows: the aims of the research and the analytical approach are described in this chapter; a review of the literature is presented in chapter 2; the analytical approach and the difficulties associated with using this approach to answer the research question are discussed in chapter 3; the data and variables used are described in chapter 4; and the results of the estimation are set out in chapter 5. Three appendices are attached, providing further detail on some of the theoretical and technical aspects of the research.

1.1 Research objectives and the analytical framework

The primary objective for this project is to analyse the impact of health status and educational attainment on labour force productivity. In particular, the focus is on six 'target' health conditions[1] that were identified by the Council of Australian Governments (COAG) in 2006 as priorities for health promotion and disease prevention under the National Reform Agenda (NRA) (PC 2006).

A second objective is to use the model developed in this paper to estimate the wages that could potentially be earned by people who are unemployed or not in the labour force if they were to become employed, assuming no change in their education or health status.

The main motivation for this research is to obtain estimates of the effects of health and education on labour productivity that could be used as inputs for future modelling of the economy-wide effects of reforms to health and education. In 2006

[1] The target health conditions are heart disease, cancer, diabetes, arthritis, mental illness and serious injury.

the Productivity Commission modelled the effects of reforms to health and education policies that were proposed under the NRA. Although the information used was the best available at the time, there were some limitations:

- The Commission relied on published estimates of the effects of health and education on labour force participation and productivity to generate the inputs that were fed into the economy-wide model. Particularly in the case of health, the literature was sparse and the estimates were not all directly relevant to the modelling task.
- Estimates of the potential productivity of people who were not employed were based on a paper from New Zealand (Bryant et al. 2004). Given the structural differences between the Australian and New Zealand economies, these estimates may not be accurate for Australia. (As it turns out, the estimates presented in this paper are consistent with the estimates based on Bryant et al. (2004) that were used in the Commission's 2006 report.)

To address these limitations, the Commission commenced two projects that used a rich dataset (HILDA) to empirically estimate the effects of education and health status on labour market outcomes in Australia. The first (Laplagne et al. 2007) estimated the effects of education and health on labour force participation. This project is the second.

The current study:

- uses Australian data to estimate the effects of a range of chronic health conditions on wages
- addresses theoretical issues arising from using wages as an indicator of labour productivity, particularly when investigating the effects of health on labour productivity
- develops a technique to estimate the effects of a range of chronic health conditions that is based on the Short Form 36 (SF-36) measure of general health
- uses Australian data to estimate the potential productivity of people who are unemployed and not in the labour force if they were to become employed.

Labour productivity and human capital

Productivity can be defined broadly as 'a measure of the capacity of individuals, firms, industries or entire economies to transform inputs into outputs' (IC 1997, p. 3). The relevant measure for this project is the productivity of individuals' labour, which is an indicator of output per hour worked. Simply put, workers who are more

productive produce more in a given period than workers who are less productive (assuming they have access to the same capital and other inputs).

'Human capital' refers to the set of attributes that each individual possesses that makes it possible for them to contribute to production. It can include knowledge, skills, health, work experience and intangible characteristics such as work ethic and motivation. Human capital is a key determinant of individuals' labour productivity.

Aside from formal education and health status, there are other human capital characteristics that are significant determinants of labour productivity. Mincer (1974) emphasised the contribution that experience makes to a person's earning capacity, and proposed a model of earnings that included experience as a non-linear variable to account for the possible decline in the rate of accumulation of on-the-job skills that comes with age. Other authors have identified gender as a factor, as men and women tend to follow significantly different paths in their human capital development and earnings growth.

Finally, it should be noted that returns to human capital (and hence labour productivity and wages) also depend on factors outside a person's control. Individuals with high levels of human capital and potentially high productivity may not be able to achieve their full potential if they do not have access to physical capital (equipment or land). (That is, human capital and physical capital are complementary.) If a person lives where they are not able to find a job that takes full advantage of their skills and attributes, their actual productivity may be less than their potential productivity. This means that returns to human capital can depend on where a person lives and the opportunities they have to apply and be rewarded for applying their skills.

The link between productivity and wages in theory

The question of interest is the effects of education and health status on labour productivity. However, individuals' productivity is difficult to observe and measure, requiring data on individuals and their employers such as their access to capital and other inputs. In practice, these data do not exist in large samples. Therefore for this analysis it was necessary to find an observable variable that is correlated with productivity. In investigating questions similar to this one, researchers have often used wages as an indicator of labour productivity. This approach rests on a number of assumptions, some of which might not fully hold in practice. This places limitations on the interpretation and conclusions drawn from studies that use wages as a surrogate indicator of productivity.

The use of wages as a surrogate indicator of labour productivity is supported using economic theory. Standard economic theory assumes that firms seek to maximise profit. This leads them to choose a level of labour hire where the cost of extra labour (wages and other expenses such as superannuation, workers compensation and administration costs) equals the increase in revenue associated with the extra output from that labour.[2] By definition, more productive workers produce more output per hour worked, so a profit-maximising firm would be prepared to pay more for more productive workers. Factors that affect a person's productivity are thereby also likely to affect the wages that firms are prepared to offer them.

In analysing the relationship between wages and labour productivity it is important to consider supply-side factors, including the elasticity of labour supply, which is related to the costs to workers of acquiring new skills and hence increasing their productivity. If the cost of acquiring new skills (including time, effort and money) is low, the supply of labour with the required skills will be more elastic and increases in labour productivity will result in small or no increases in wages. If the cost of acquiring skills is high, labour supply would be expected to be less elastic and wages more responsive to changes in labour productivity that are brought about by skill acquisition.

In a competitive labour market, with perfect information, mobility of labour, no transaction costs and constant returns to scale, equilibrium wages at the margin would just compensate for the costs of acquiring the additional skills, and in turn would equal the additional productivity generated by those skills. However, given these are unlikely to hold, an individual's wages will rarely be equal to their marginal revenue product of labour. Over longer periods, where markets for goods and services and labour are competitive, changes in wages and differences between the earnings of people with different human capital characteristics are likely to be a reasonable indicator of labour productivity. However, it should be noted that at any given time, individuals' wage levels may under- or overstate their labour productivity.

[2] The increase in revenue resulting from output produced by marginal labour is the marginal revenue product of labour (MRP_L) — the extra output multiplied by the price of the product. In a competitive product market, MRP_L equals the value of the marginal product of labour.

The link between productivity and wages in practice

The following sections compare the assumptions in economic theory about the relationship between wages and productivity with the reality of labour markets. In particular, two issues are addressed:

- how education and health status affect workers' productivity
- whether wages reflect the effects on workers' productivity that are attributable to their education and health status.

How is educational attainment expected to influence productivity?

Higher levels of education are expected to be associated with higher levels of labour productivity for two reasons:

- Education leads to the accumulation of skills that make workers more productive. Such skills can be job-specific (for example, skills learned from plumbing or medical qualifications) or broad (for example, literacy and numeracy).
- Employers might choose to employ highly educated workers because education can be a 'marker' of unobservable characteristics such as work ethic and intrinsic motivation. These characteristics are associated with higher productivity. This is referred to as the 'signalling' effect of education.

Are wages likely to reflect education-induced changes in productivity?

The extent to which education-induced productivity is reflected in higher wages depends on the characteristics of the labour market. There are a number of reasons why the productivity-enhancing effects of education are likely to be reflected in higher wages, including:

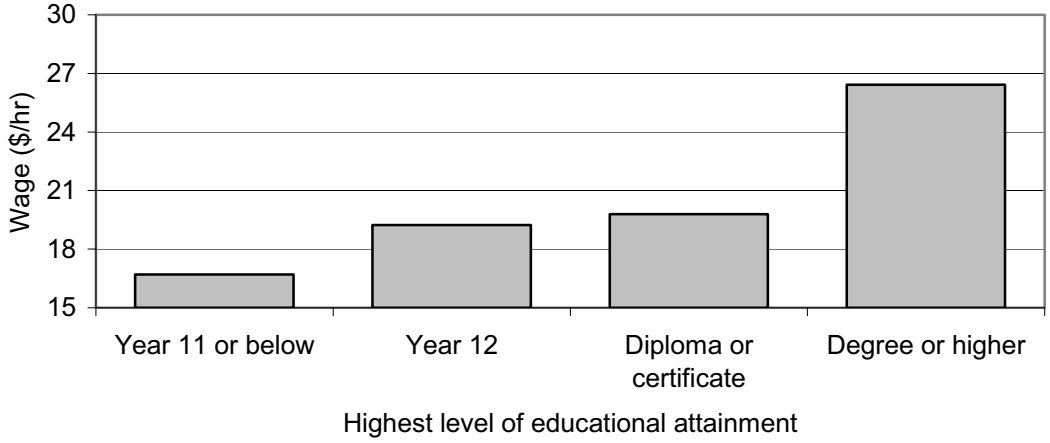
- Although productivity cannot be directly observed by prospective employers, educational attainment can. Where employers perceive that higher levels of education are positively associated with higher productivity, they might reward higher levels of education with higher wages. Over time, employers whose perceptions of employee productivity are most accurate are likely to have an advantage over competitors.
- If employers place a higher value on educated workers and labour markets are competitive, more educated workers are likely to achieve higher wages. This means that even if wages do not immediately respond to changes in individuals' educational attainment, over time they can seek higher wages (either in their current job or elsewhere). Therefore, over the course of their working lives, a

person's wages would be expected to adjust in line with their level of educational attainment.

- One countervailing factor is the possibility that some workers prefer jobs that pay a lower wage than they could earn elsewhere because they gain intangible benefits from the lower-paid job. Characteristics associated with lower wages might include greater flexibility in hours, location or travel time, or some other characteristic that leads them to prefer the job despite the lower wages.
- Along similar lines, some people might face barriers to entry — either real or perceived — into jobs for which they are qualified. This could include linguistic, gender or cultural barriers that prevent them from earning wages that reflect their level of education and productivity.

The link between education and wages is borne out in an established academic literature (both Australian and overseas) and is readily observable in the data used for this project (figure 1.1). This gives support to the assumption that wages are a useful indicator of labour productivity, although it is unlikely that there is a one-to-one relationship between wage variations and education-based differences in productivity.

Figure 1.1 **Mean hourly wages increase with higher levels of education, 2001–2005[a]**



a Mean wages are standardised for age and gender.

Source: Household, Income and Labour Dynamics of Australia (HILDA) Survey, Waves 1–5.

How is health status expected to influence productivity?

As a component of human capital, health makes an important contribution to a person's productivity. The literature identifies two channels through which ill health reduces workers output and productivity: absenteeism from work and 'presenteeism'.

Grossman (1972) conceives of health as a 'durable capital stock that produces an output of healthy time'. This healthy time is then allocated between leisure and work, with poor health limiting the amount of healthy time that may be allocated to generating income. This conception of health describes the effects of absenteeism on labour productivity.

As well as influencing the amount of healthy time available for work, health also influences the quality of the time available. The fact that a person is healthy enough to come to work does not necessarily mean that they are working at their potential. The loss of productivity that occurs 'when employees come to work but, as a consequence of illness or other medical conditions, are not fully functioning' (Econtech 2007, p. ii) is referred to as 'presenteeism', and it is a source of health-related productivity loss.

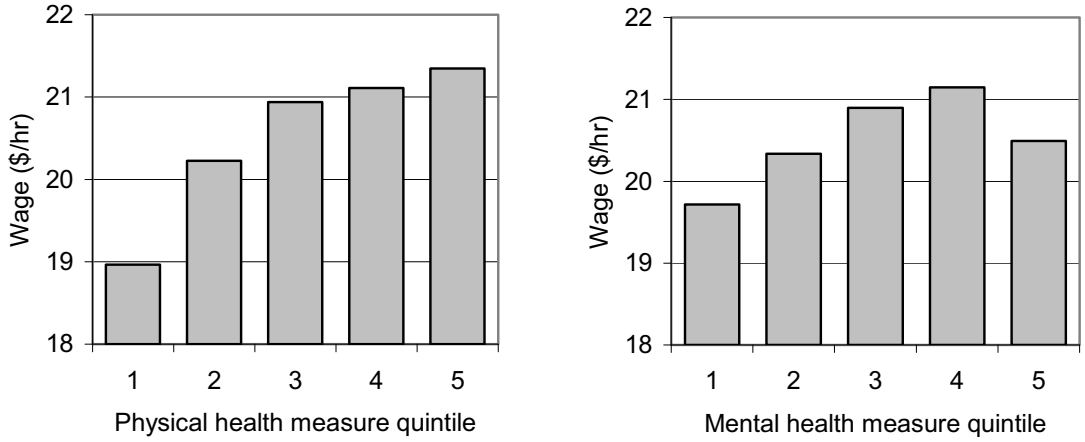
Ill health that leads to absenteeism or presenteeism reduces the output and productivity of affected workers (and also potentially the productivity of co-workers).

Are wages likely to reflect health-induced changes in productivity?

Ill health (including the COAG target health conditions) can lead to lower labour productivity through absenteeism and presenteeism. Figure 1.2 shows that there is a positive relationship between physical and mental health and wages (although people with the highest levels of mental health earn less than people in the third and fourth quintiles).

Although there is evidence of a positive relationship between health and hourly wages, the way labour markets function suggests that wage differentials might not capture all of the effects of ill health on labour productivity.

Figure 1.2 **Mean wages, by physical and mental health measures** [a,b]



[a] Physical and mental health are measured using the SF-36 Physical and Mental Component Summaries. See Appendix B for more information on these health measures. [b] Mean wages are standardised by age and gender.

Source: Household, Income and Labour Dynamics of Australia (HILDA) Survey, Waves 1–5.

One important difference between education and health status is that it is generally possible for employers to observe the education levels of employees (or potential employees). Employers can therefore choose to pay higher wages to more educated employees, if they consider that they are likely to be more productive. It is much more difficult for employers to observe or predict the health status of employees or potential employees, and for employees to predict their own health status.

As a protection against the financial consequences of unpredictable episodes of ill health, most permanent employees are entitled to sick leave. This has the effect of insuring the employee against some of the potential loss of wages due to illness. Employers presumably cover the costs of sick leave by paying somewhat lower wages to all employees. This is likely to lead to more muted responses of an individual's wages to an episode of ill health than if there were no provision for sick leave.

As well as sick leave, there are a number of regulations and conventions that protect unwell workers from wage cuts, provided they are still well enough to attend work. The effect of these regulations is likely to transfer some of the costs of illness onto employers and colleagues. Some of the protection from wage cuts derives from the conditions under which people are employed. For example, many employment agreements stipulate drawn-out procedures for dealing with underperformance. This can make it difficult for employers to change their employees' wages, even if illness leads to significant reductions in their productivity. Like sick leave provisions, such regulations and conventions are likely to lead to muted wage responses to ill health.

A further issue to consider is the effect of illness on co-workers. Pauly et al. (2002) develop a model of the effects of illness on output and labour productivity to analyse the impact of absenteeism on employers and employees. They show that in a simplified model where homogeneous workers produce output individually (not as part of a team) and that output can be stored at zero cost:

> [t]he cost to the firm when a worker is absent due to illness is the worker's marginal revenue product, which is equal to the wage. (Pauly et al. 2002, p. 223)

Pauly et al. then consider a more complex and realistic model of firms that use team production processes. When workers work as a team, the absence of one member can reduce the productivity of the whole team, particularly if the absent worker has skills that can not easily be replaced (that is, where good substitutes are not available). Pauly et al. show that:

> … when there is a team production and substantial team-specific human capital, the value of lost output to the firm from an absence will exceed the wage per day of the absent worker. (p. 226)

This suggests that using wages as an indicator of productivity will tend to understate the negative effects of absenteeism on labour productivity. As well as losing the production of the absent worker, there is a flow-on effect that reduces the productivity of the rest of the team, so the lost productivity exceeds the wage of the absent individual.

Pauly et al. observe that the costs of absenteeism due to illness are likely to vary from firm to firm, and state that the costs are likely to be largest at firms where the inventory is perishable. They give the example of an airline that is forced to cancel a flight because the pilot is absent and will never be able to recoup the lost revenue. The cost to the firm of the pilot's illness would far exceed the pilot's wage.

The model developed by Pauly et al. implies that productivity losses that are caused by presenteeism are also likely to be larger in firms that use team production processes. Presenteeism leads to lower productivity from some workers who remain at work in spite of illness. Workers who are 'present' may produce less output for every hour they attend work (that is, they have a below-normal level of productivity). If they are self-employed, this behaviour reduces their income.[3] For employees the lower productivity reduces the revenue that their employer gains from employing them, but does not necessarily reduce the employee's hourly

[3] Data issues meant that self-employed people were excluded from this study.

wages.[4] At least part of the reduction in workers' productivity is borne by the employer. This reduces the productivity and profitability of the firm, and the aggregate productivity of the labour force — which will affect the overall level of wages — but does not show up in data on individual wages.

The effects of presenteeism on firms are likely to vary depending on the duration of the employee's illness. If it is short-lived, firms may respond by requiring their remaining employees to pick up the slack. This effectively passes the costs of the illness onto the other employees who are required to work harder or longer hours to meet the shortfall due to their colleague's illness. In the longer run, this situation is unlikely to be tenable, and the firm will have to replace the sick worker, or adjust to a permanent fall in output, labour productivity and profits.

The unpredictable nature of illness, provisions for sick leave and labour market conventions mean that the response of individual wages to ill health is likely to be muted. Presenteeism and the effects of team production suggest that some of the costs of a person's ill health might be borne by their employer and by co-workers. Therefore using individuals' wages as an indicator of the effects of health on labour productivity might tend to understate the negative effects of ill health on productivity.

There are also statistical issues that could imply that the results obtained using hourly wages as an indicator of the effects of health on productivity might not reflect the true relationship between health and productivity. For example, if higher wages lead to better health, and at the same time better health leads to higher wages, 'endogeneity bias' might lead to results that overstate the positive effects of good health on labour productivity. Statistical issues are discussed further in chapter 3.

[4] For workers whose employment agreements include the scope for performance bonuses, reductions in productivity due to illness may result in them not receiving bonuses (or receiving less). In this way, some of the effects of health on productivity would be reflected through wages.