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Measuring and valuing productivity loss due to poor health: A critical review

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ABSTRACT

The objective of this study is to review current measurement issues and valuation methods such as "human capital" and "friction cost" for estimating productivity loss due to illness. Since observed wages diverge from marginal productivity when allowances are made for sick days and workers are risk averse, or when a job type involves team production, unavailability of perfect substitutes, and/or time-sensitivity of output, productivity loss is likely to be underestimated. A multiplier adjusting wage to marginal productivity needs to be developed for practical use. We further consider the ramifications of measuring labour input loss due to illness in both paid and unpaid work as well as the inclusion of presenteeism to the more traditional approach of measuring only absenteeism. Although a number of instruments have been developed to measure presenteeism, they generate widely varying estimates of productivity loss. Further investigation is required to identify which instrument provides a better estimate. Finally, we provide recommendations on measurement methods such as using subjective measures due to the unavailability of objective measures and the appropriate recall periods. We conclude by proposing a generic measure instead of a disease-specific measure and discuss important perspective related issues.

Introduction

Recently, there has been a marked increase in the number of published papers that focus on estimating the economic burden of illness especially chronic illness. In most instances, these newer studies are different from their predecessors because of the inclusion of the indirect costs of the disease (Anis, Zhang, Bansback, Guh, Amarsi, & Birmingham, 2010; Health Canada, 2002; Health Canada, 2003; Li, Gignac, & Anis, 2006). Indirect costs are now widely referred to as productivity losses (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005; Gold, Siegel, Russell, & Weinstein, 1996). In addition to estimating the economic burden of illness, cost-effectiveness studies also include indirect costs albeit as a sensitivity analysis according to the recommendations of most national pharmacoeconomic guidelines (Canadian Agency for Drugs and Technologies in Health, 2006; National Collaborating Centre for Chronic Conditions, 2009; National Institute for Clinical Excellence, 2001; Ontario Ministry of Health and Long-Term Care, 1994). However, there is considerable skepticism about considering indirect costs. Their inclusion in economic evaluations is viewed as a tactic to improve the cost-effectiveness of interventions from a societal perspective. Some are of the opinion that their inclusion in cost-effectiveness analysis results in double counting while others raise concerns over the issues of equity, perspective and valuation methods, etc to argue against the inclusion of indirect costs in economic evaluations. (Drummond et al., 2005; Gold et al., 1996; Sculpher, 2001).

In order to address the issues, health economists have made recommendations on how to report productivity loss in economic evaluations. For example, to avoid double counting, it was suggested to ask individuals to assume no health care costs or income loss as a result of illness while assessing the value of improved health (Drummond et al., 2005; Johannesson, Jonsson, Jonsson, Kobelt, & Zethraeus, 2009; Pritchard & Sculpher, 2000). To balance efficiency with equity, productivity loss should be first expressed in quantities such as the number of lost days or hours of work and then valued as a monetary amount using more equitable estimates such as a general wage rate (Drummond et al., 2005; Pritchard & Sculpher, 2000).

Although a societal perspective is preferred for economic evaluations, different perspectives, especially a health care budget perspective, are often adopted (Drummond et al., 2005; Gold et al., 1996; Johannesson et al., 2009; Jonsson, 2009). Jonsson (2009) provided ten arguments for taking a broad societal perspective on value, specifically to include all relevant costs including productivity loss. Therefore, productivity loss should be presented separately from health care costs to give the decision makers explicit information about the impact of different assumptions on the result (Drummond et al., 2005; Johannesson et al., 2009; Pritchard & Sculpher, 2000).

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Despite of the recommendations on reporting productivity loss, there is still a lack of detailed methodological guidance on how productivity loss should be measured and valued. In this paper we introduce the concept of productivity and distinguish between labour as an input and its productivity impact on the final output of the firm. We first review current valuation methods of productivity loss and the related issues. Then, we consider the ramifications of loss in both paid and unpaid work productivity and address current controversies with regard to the measurement of productivity loss. We do not attempt to address the current issues with regard to inclusion/exclusion of productivity loss in economic evaluations. Instead, in this paper, we focus on measuring and valuing productivity loss as a result of morbidity. We believe that productivity loss should first be measured as comprehensively as possible and then be included/excluded according to the needs of the decision makers.

Productivity and productivity loss

According to neoclassical economic theory, the concept of productivity is based on the production function, where output is a function of capital input, labour input and technology allowing for substitution between different types of inputs. Productivity is a measure of output per unit of input (Organisation for Economic Co-operation and Development, 2001). Labour input reflects the quantity (e.g., time) and quality (e.g., effort and skills) of the work force. In the context of this paper, productivity loss due to health problems refers to the output loss corresponding to the reduced labour input due to health problems.

Valuation of productivity loss: paid work

According to the above definition of productivity loss, to value productivity loss is to value the output loss. There are two main valuation methods for productivity loss among the employed. The human capital (HC) approach treats human beings as assets and values life and health as lost production to the economy (Berger, Murray, Xu, & Pauly, 2001; Johannesson, 1996). It assumes that the value to society of productivity loss should be measured as the present value of lost time according to the market wage, which is supposed to equal the marginal revenue product (MRP) of labour in a competitive labour market. While the Friction Cost (FC) method has been suggested as an alternative to the HC approach, it is really a refinement of the HC approach in that it attempts to adjust for worker replacement in a friction period and considers additional replacement costs. The proponents argue that when someone is away from work, productivity falls only for a limited time period until a substitute worker replaces the absent worker and production loss is minimized (Koopmanschap, Rutten, van Ineveld, & van Roijen, 1995).

Both methods above use the market wage rate as the proxy value of marginal output loss at the firm level. However, observed wage may not equal MRP for many reasons. Putting aside instances of imperfect labour markets where the wage may reflect inequities such as race or gender discrimination or employer/employee market power, allowances for sick days and risk aversion of workers will compel them to accept a wage rate that is below their marginal productivity (Pauly, Nicholson, Xu, Polsky, & Danzon, 2002). Simply stated, the market wage rate is less than the value of a worker's marginal productivity primarily due to the existence of risk aversion and unpredictability of sick days. In a perfectly competitive market, where the firm is a price taker in both the product and factor markets, profit maximizing employment is achieved where the wage rate equals MRP, i.e., where the marginal cost of employing labour equals the marginal revenue to be gained from employing labour (Smith, 2003). If no sick leave occurs, employers will pay employees a wage rate of w^*, which is equal to MRP of labour ($w^* = \text{MRP}$). When illness occurs, an absent employee will not receive any wages. Therefore, in the absence of a fixed employment contract, employees face a gamble of receiving a wage of 0 or w^*. As shown in Fig. 1, the utility of a fixed wage is higher than the expected value of the gamble. Employers therefore are able to offer employees a wage $w < w^*$ i.e., $w = w^* \times (E - a)/E$, where a is the predicted number of sick days and E is the assumed total annual workdays in a fixed employment contract (Pauly et al., 2002). For example, when a is predicted at 26 days and E is 260 days (52 weeks $\times$ 5 days per week), there are 3 options, A, B, and C, on a wage as valued at 0, 0.9w*, and w^*. Employees would prefer option B to a 10/90 gamble of receiving A or C (Fig. 1).

Furthermore, the divergence between the observed wage rate and actual productivity of workers can be accentuated if a job type involves team production, unavailability of perfect substitutes, and/or time-sensitivity of output (Pauly et al., 2002; Nicholson et al., 2006; Pauly, Nicholson, Polsky, Berger, & Sharda, 2008). Therefore, when an employee is absent from work, the actual productivity loss will exceed his or her wage if a substitute cannot be found or the hired substitute is less productive or costs more AND if team work is involved and/or penalties occur for failure to achieve the targeted output levels. For example, it is hard to replace a cardiac surgeon because of their specialized training. The absence of the surgeon from a pre-scheduled surgery will idle the entire surgical team including nurses and the anesthetist. The productivity loss attributable to the surgeon's absence will certainly not be his or her wage only but the value of the entire team's output. Similarly, in a firm where output is highly time sensitive, i.e., losing the customers if delivery schedules are delayed or deadline is missed, the absence of a worker will have a ripple effect and will certainly have a value much greater than his or her wage if a perfect substitute is not available.

To better value work productivity loss, we need to consider whether wages adequately reflect the value of production at the margin. It requires a dataset linking employees' labour input to their employer's output. However, it is impractical and costly to set up such a dataset for each single economic evaluation study.

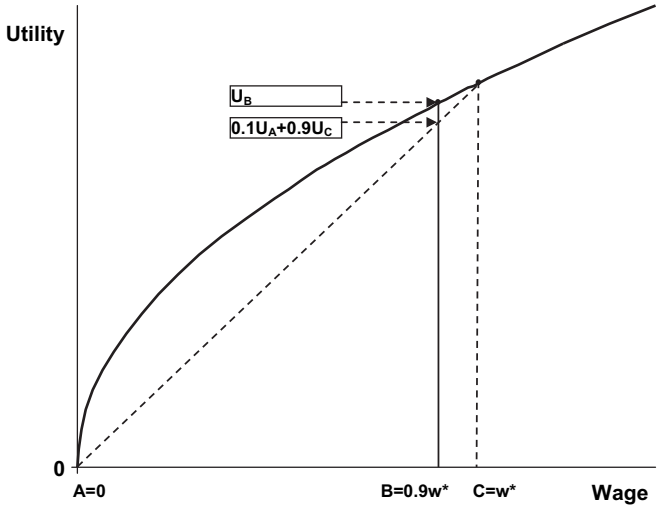

Fig. 1. Risk aversion with respect to uncertain wages. The wage employers offer employees $w = w^* \times (E - a)/E$, where w^* = marginal revenue product, a is predicted number of sick days and E is assumed total annual workdays. When $a = 26$ days and $E = 260$ days, there are 3 options of wage, $A = 0$, $B = 0.9w^*$ and $C = w^*$. Employees would prefer option B to a 10/90 gamble of receiving A or C, i.e., $U_B > (0.1U_A + 0.9U_C)$.