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ORIGINAL RESEARCH

Some adjustments to the human capital and the friction cost methods

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Abstract
The cost of lost output is a major component of the total cost of illness estimates, especially those for the cost of workplace accidents and diseases. The two main methods for estimating this output, namely the human capital and the friction cost method, lead to very different results, particularly for cases of long-term absence, which makes the choice of method a critical dilemma. Two hidden assumptions, one for each method, are identified in this paper: for human capital method, the assumption that had the accident not happened the individual would remain alive, healthy and employed until retirement, and for friction cost method, the assumption that any created vacancy is covered by an unemployed person. Relevant adjustments to compensate for their impact are proposed: (a) to depreciate the estimates of the human capital method for the risks of premature death, disability or unemployment and (b) to multiply the estimates of the friction cost method with the expected number of job shifts that will be caused by a disability. The impact of these adjustments on the final estimates is very important in terms of magnitude and can lead to better results for each method.

Keywords Cost of illness · Human capital · Friction cost · Vacancy chains

JEL Classification I150 · J390

Introduction

The cost of lost output is a major component of the total estimate in cost of illness (CoI) studies, especially in those for the cost of occupational accidents and diseases.

However, unlike other kinds of "hard" costs that can be reliably measured (e.g. medical costs), these "soft" costs are estimates and, therefore, they are greatly dependent on the methods and assumptions used.

There are two prevalent methods in such studies: the human capital method [1, 2] and the friction cost method [3]. The former estimates lost output costs as the sum of wages (as a proxy of the value of the marginal product from work) during the time of absence, whereas the latter only takes into account transition costs until output is restored to previous levels (e.g. substitution of the worker) assuming that idle human capital in the society (unemployed or under-employed) will cover up for the lost human capital of the disabled person.

Although these methods are frequently presented as conflicting alternatives [4–6], some other studies [7, 8] actually use them both for different aspects (human capital costs for the individual and friction costs for employers). However, in studies that examine the societal aspect, this dilemma is essential. The impact of choosing one or the other method on the final estimate is large, as lost output accounts for the majority of tangible costs particularly for long-term absence from work, where worker needs to be replaced.

In the debate for the comparison of the two methods, the human capital method has been criticised for overestimating costs, whereas the friction cost method for underestimating them. The size of these differences is very large in relevant studies, even in order of magnitude. Moreover, due to its large proportion in the total cost for the society, its impact on the total estimate is also large.

In this paper, two hidden assumptions (one in each method) that intensify these differences are discussed, along with suggestions to amplify their impact, thus improving the estimates of both methods.

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The first assumption is included in the human capital method and can be shortly described as "the invulnerable avoider assumption". By projecting the total sum of future wages of the victim as the cost of forgone output, it is silently assumed that had this incident been avoided, this person would remain alive, healthy and employed for a long time, even until retirement age (for permanent disability or death).

However, people are subject to premature death, temporary or permanent disability (from other cause than the examined illness) or unemployment, that prevent them from working. This average idle time per individual has to be taken into account in relevant studies.

Although some studies (e.g. [7]) include an adjustment for life expectancy, disability due to other reasons, as well as unemployment need also to be taken into account to depreciate the nominal work-life. The suggestion of this paper for such a adjustment is described in "Methods".

The second assumption is included in the friction cost method and it has been identified and criticised by Johanneson and Karlsson [4] more than two decades ago, soon after the friction cost method was presented.

This method silently assumes that a vacancy created by the disability of a worker will be filled by a previously unemployed person. However, this is not always the case, as a large part of the vacancies is filled by already employed workers leaving their current job, thus creating another vacancy. Therefore, any (minor) disturbance in the labour market, caused by a worker's disability, will create a number of job shifts and, consequently, a number of "friction costs" to other employers that could multiply the total cost estimated with this method. This disturbance has been studied by the vacancy chain approach [9] and relevant literature. In this paper, an adjustment to compensate for this assumption is also proposed in "Methods".

It has to be mentioned that this cost is external to the enterprise, as it falls to other enterprises, where substitute workers come from. Therefore, this cost is taken into account in studies that examine the societal perspective.

Methods

The first proposed adjustment has to do with the human capital method. As argued in "Introduction", the sum of wages during absence, may overestimate the value of the forgone output due to the disability. Any individual is susceptible to death or disability due to other conditions than the examined illness, as well as to unemployment. These risks reduce the expected output of the individual for any given time and, therefore, the nominal output (i.e. wage · time) should be accordingly depreciated.

This adjustment can take place through the "Proportion of life Disability free" (PlDf) coefficient, which is calculated as follows:

$$\mathrm{PlDf} = \frac{\mathrm{DfLE}}{\mathrm{LE}}$$

where DfLE is disability-free life expectancy, LE is life expectancy.

This coefficient depreciates the nominal output for the risks of death or disability due to other conditions than the illness examined. To also take into account the likelihood that the worker is fit and willing to work but cannot find employment, it should also be depreciated for unemployment. This adjustment can easily take place with another coefficient equal to $1 - u$, where u is the rate of unemployment.

Thus, the total expected output (EO) can be estimated as:

$$\mathrm{EO} = t \cdot \mathrm{PlDf} \cdot w \cdot (1 - u)$$

where t is the time of absence, w is the nominal wage.

Since PlDf changes with the age and it is provided for different age classes, for long-term disability of fatalities the term $t \cdot \mathrm{PlDf}$ should be adjusted as follows:

$$t \cdot \mathrm{PlDf} = \sum t_i \cdot \mathrm{PlDf}_i$$

where t_i is the years of disability within the age class i, PlDf_i is the proportion of life disability free of the age class i.

The sum should start from the age of disability until the age of retirement. For studies other than those for occupational accidents and diseases, an adjustment for the employment rate should also apply.

The second adjustment has to do with the friction cost method and more specifically with its hidden assumption that any vacancy created by a worker's disability will be directly covered by an unemployed person. Relevant literature based on the work of White [9], supports that such a vacancy can either be covered by an unemployed person or an immigrating worker (a case not examined here) or an already employed person looking for a better employment. The latter would start a vacancy chain that could cause multiple friction costs depending on its length (i.e. the number of job switches until an unemployed or immigrating worker covers one of the domino-vacancies). The length of the vacancy chain is not easy to estimate and changes with the business cycle.

Vacancy chain literature differentiates its estimates for different levels of job seniority for each category of job candidates. However, to keep the adjustment simple, a rough estimate has been proposed in [10]:

$$\mathrm{LVC} = \alpha \frac{(1 - u)}{u}$$

where α is the proportion of already employed jobseekers and LVC is the length of the vacancy chain.

The proportion of employed jobseekers can be found in Labor Force Surveys. Of course, these two parameters are correlated, as higher unemployment usually means that less workers are willing to leave their existing employment position. In general, the length of vacancy chains is procyclical [10–12], i.e. the lower the unemployment rate, the longer the vacancy chains.

The adjustment proposed in this paper is to multiply the friction cost with the expected length of vacancy chains. This would compensate for the expected number of friction costs that would be initiated by a disability. Although it is not an accurate calculation, this effect cannot be neglected when estimating the friction costs of any (minor) disturbance.

Results

The value of forgone human capital varies between different countries due to differences in levels of wages, as well as in mortality and morbidity (time of absence). The proposed adjustment reduces the impact of morbidity and mortality of the examined illness by taking into account the overall morbidity and mortality.

According to the statistical tables for UK [13], the PlDf ranges between 77 and 53.9% for working ages, whereas unemployment rate in this country is particularly low (4.2%).

In any case, for the certain country, the final adjustment in terms of order of magnitude would be around 30–40% of the output value calculated with the human capital method without taking these factors into account. This depreciation would be higher in countries with higher unemployment rates.

Regarding the adjustment in friction cost method, it is not easy to calculate directly, as the percentage of already employed job seekers changes with the business cycle (procyclically), just like unemployment rate also does (countercyclically). Based on UK Labour Force Survey data, the percentage of employed job seekers (α) ranges between 30 and 55% [14]. Such an α coefficient would produce a length of vacancy chain (and consequently an adjustment) equal to or over 5.6. Of course, this would be lower in countries with higher unemployment rates.

However, even in the certain case of the UK, this might be an overestimate for two reasons:

- the existence of immigrating workers that can reduce the vacancy chain [10]
- the qualitative difference of jobs, as employed workers are seeking only for "good jobs", which is not the case for unemployed workers who are more available for any kind of jobs [15].

Further research is required to have more accurate estimates of the α factor and, consequently, the length of value chain.

The total impact of the unemployment is reverse for these two methods. Unemployment reduces the value of forgone output as calculated with the human capital method, whereas it increases the value estimated with the friction cost method. Although it is yet uncertain to present clear results, the combined adjustments could lead to some convergence of the estimates of the two methods, at least in terms of order of magnitude.

Discussion

There is a long debate in literature between the supporters of the one or the other method. The human capital method has been criticised for overestimating costs, whereas the friction cost method for underestimating them. In the main official periodic national estimates for the costs of accidents and diseases at work, friction costs method results for lost output are as low as 2.6% [7] to 8.8% [8] of the results with the human capital method.

The adjustments proposed in this paper concern both methods and actually emphasise on the role of unemployment in the cost of the forgone output. None of the two prevailing methods takes that parameter directly into account in relevant studies. However, unemployment, i.e. the extent to which the available human capital cannot be fully utilised, should be seriously taken into account when estimating the cost of lost output due to an illness.

In general, after these adjustments, the estimates of both methods converge, although this is not the aim of this paper; the adjustments are proposed to improve the assumptions and results of the methods regardless of whether final estimates are converging or not. Although such a convergence is welcome for the reliability of relevant studies, since estimates with the one or the other method will not have large differences, it cannot be expected that the choice of method will be indifferent for the results. These two methods take into account and calculate different elements that cannot lead to similar results in all cases. Moreover, the extent of convergence depends on the size of unemployment: it changes the results of both methods in opposite directions, but the magnitude of this change is not uniform.

Of course, these adjustments can be further elaborated and constitute a first step to improve the calculation of lost output due to an illness. However, even in this initial form, they could produce better results than without taking them into account at all, as, given the dominant share of output-related cost to the total cost in relevant studies, the choice of the one or the other method or using the proposed

adjustments or not, actually defines the order of magnitude of the final estimate.

Conclusions

The two main methods used for the estimation of the cost of lost output in cost of illness studies, namely the human capital method and the friction cost method, lead to very different results. Since this cost is the major part of the total tangible costs of the examined illness, especially for those studies that estimate cost of occupational accidents and diseases, the choice of the one or the other method defines the total estimate. Two hidden assumptions that affect the estimates of these methods are:

- For the friction cost method that any vacancy due to disability is filled by a previously unemployed person so that only one friction cost occurs.
- For the human capital cost that the expected future outcome of the disabled person equals the total wages for the period of their disability, so that this person would be alive, healthy and employed had the incident not occurred.

Two adjustments were proposed for the improvement of the results of these methods. Both of them have an important impact to the direction of convergence of the results calculated with each one of them. These adjustments do not provide a new methodology for the estimation but can provide better estimates than if ignored.

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