A Revision of Statistics Canada's Estimates of Labour Input for the Productivity Accounts

Labour input reflects the time, effort and skills of the work force. If labour input is calculated as the simple sum of all hours of all workers, no account is taken of the heterogeneity of labour.

In the context of productivity measurement, the question is whether, over time, the composition of the labour force changes, that is, whether there is an increase or decrease in the average quality of labour input. Taking account of changes in the composition of labour is important from several perspectives.

First, it provides a more accurate indication of the contribution of labour to production. This has implications for growth accounting: growth in output is attributed to growth of combined inputs and a residual growth in multifactor productivity. When a quality-adjusted measure of labour input is used in growth accounting instead of unadjusted hours worked, a larger share of output growth will be attributed to the factor 'labour' instead of the residual factor 'general productivity growth'. In other words, a quality-adjusted labour input measure can separate the impact of investment in human capital from other sources of growth, such as externalities or spillovers, that are captured by the general productivity residual. Second, comparison of adjusted and unadjusted estimates of labour input can yield information on how particular compositional changes affect productivity.

In the literature and in statistical practice there have been different approaches to estimating quality-adjusted labour input.

The approach developed by Jorgenson et al. (1987) uses as many as six characteristics (age, education, class of workers, gender, occupation, and industry) to cross-classify labour. Average wage rates and income shares are calculated for workers grouped by these characteristics. Because still other worker characteristics may affect incomes, the labour composition measure reflects both the direct contributions of the classifying characteristics as well as interaction effects from other characteristics not included.

Another possibility is to use a smaller number of differentiating characteristics to group workers and use statistical regression techniques to isolate the impact of other influences on average wage rates. This is the approach adopted by the United States Bureau of Labor Statistics. They cross-classify hours worked only by educational attainment, work experience, and gender. A regression approach also facilitates identification of the impact of particular sources of change on labour composition (Bureau of Labor Statistics, 1993).

Whether there is only one or whether there are several differentiating traits, hours of highly skilled persons and hours worked of unskilled persons cannot simply be added to obtain an aggregate measure of labour input - they have to be weighted by their respective relative productivity to account for differences in

skills. The theory of the firm stipulates that, under certain conditions (the firm is a price-taker on labour markets and aims at minimizing its total costs), labour of a certain type will be hired up to the point where the cost of an additional hour of labour is just equal to the additional revenue that using this labour generates. This equality implies that, to get a measure of total labour input that reflects differences in relative productivity, the individual hours of different quality can be weighted with their respective relative wage rates, or more precisely, with the share of each type of labour in total labour compensation.

Thus, the growth rate of total, quality-adjusted labour input L is measured as in (1) where Ha stands for the hours of a particular type of labour, and where v_a is the share that labour type a occupies in total labour compensation.

$$\frac{d \ln L}{dt} = \sum_a v_a \frac{d \ln H_a}{dt} \qquad (1)$$

Note that even when only a simple trait such as occupation is chosen to differentiate labour input, information requirements are substantial: data is needed that distributes the number of total hours worked across different occupations, by individual industry and by individual years. In addition, quantity measures of labour input (hours worked) have to be accompanied by price measures (relative average compensation) to construct weights for aggregation. Such rich datasets are normally both difficult and costly to collect and therefore not readily available in practice.

Quality adjustment of labour input in Canada

Statistics Canada's productivity program has developed measures of quality-adjusted labour input, in line with both approaches outlined (see References). Both approaches gave similar results in recent years. The Jorgenson style approach will be used in the future because it will be computationally simpler. A brief description of it follows.

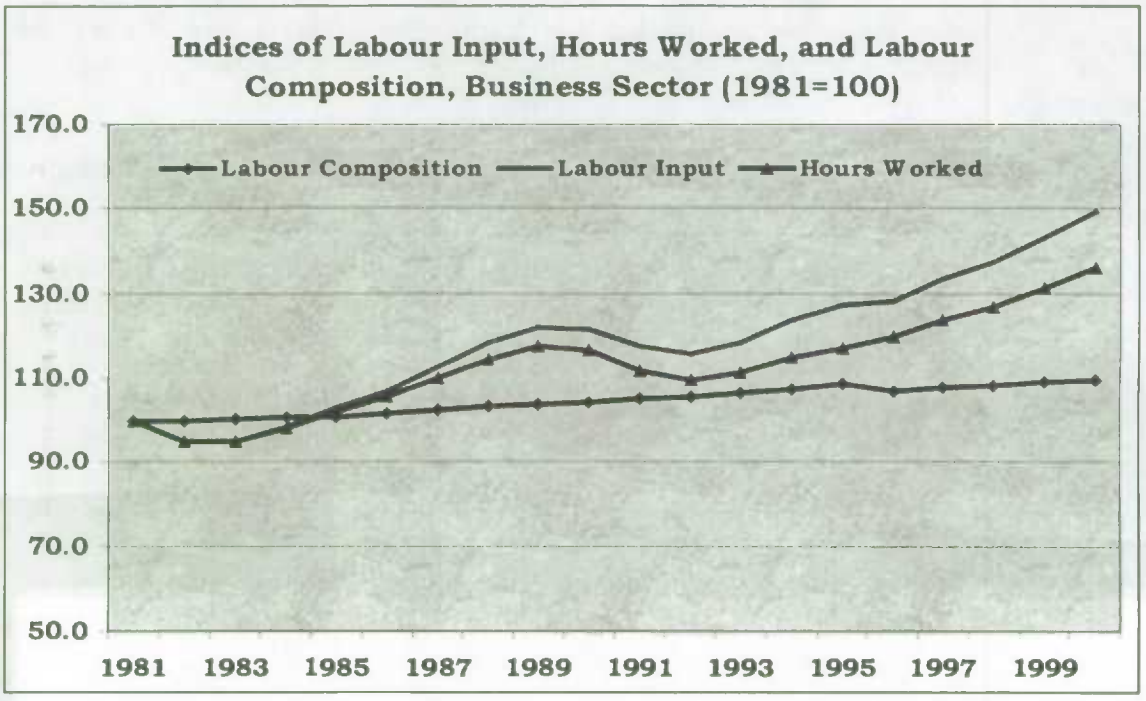
The data on hours worked and worker earnings were taken first from the Census of Population for 1961, 1971, 1981, 1986, 1991 and 1996, then from the Labour Force Survey and the Survey of Consumer Finance for the years between the Census benchmarks, and then from a number of other household and business surveys, as needed, and adjusted to be consistent in aggregate with the System of National Accounts.

Workers were cross-classified by: 7 age groups (15-17, 18-24, 25-34, 35-44, 45-54, 55-64, 65+), 4 educational levels (any elementary, any high school, any post-secondary excluding completed university, any university degree), 2 classes of employment (paid employees, other), and 147 industries. This resulted in 112 types of workers for each industry, or 16,464 categories in all. Income shares in each category were calculated by dividing total compensation in the category by total compensation over all categories.

Percent change in quality-adjusted labour input was calculated with a year to year formula equivalent to equation (1) above. Percent change in labour

composition is the difference between the percent change in quality-adjusted labour and the percent change in actual hours, summed over all categories.

The actual indices of quality-adjusted labour input, actual hours, and labour composition were set to 100 for 1981. The above-calculated percent changes were used to calculate the indices for subsequent years. The graph below shows results aggregated over all industries in the form of three indices: a) the total number of hours, b) the labour input and c) the quality index of labour input (a ratio of the latter to the former).



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