Methodology of developed decomposition of contributions related with the labour factor to gross value added growth in the framework of KLEMS productivity accounts for total Polish economy and by voivodship

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A developed decomposition of contributions related with the labour factor that includes a detailed industry level decomposition by labour types seems to open new avenues for economic analyses. This opportunity has been further enhanced thanks to carrying out the decomposition not only for the total Polish economy but also at voivodship level. This concerns in particular the changes in the business cycle, the labour market, economic shocks (both external and arising from country situation and its policy) resilience, and spatial distribution of these phenomena. It can also allow to build connections with other studies.

In KLEMS productivity accounts the contribution of the relative growth of the labour factor, understood as labour services, to gross value added (GVA) relative growth rate is being divided into the contributions of two sub-factors:

$$\overline{w}_{jt}^{L}\Delta\, ln\, L_{jt} = \overline{w}_{jt}^{L}\Delta\, ln\, LC_{jt} + \overline{w}_{jt}^{L}\Delta\, ln\, H_{jt} \qquad (1)$$

where:

$$\Delta lnLC_{jt} = \sum_{l} \bar{v}_{ljt}\Delta lnH_{ljt} - \Delta lnH_{jt} \qquad (2)$$

In the above-mentioned formulae $\overline{w}_{jt}^{L}$ is the average share of the labour factor remuneration in GVA of industry j between two discrete time periods (t-1) and t. $\Delta\, ln\, L_{jt}$ is the relative growth of the labour factor value (labour services) in industry j between two discrete time periods $(t-1)$ and t, and $\Delta\, ln\, H_{jt}$ is the relative growth of the number of hours worked in industry j between these two discrete periods. $\Delta\, ln\, LC_{jt}$ is the relative change in the so-termed labour composition in industry j between two discrete time periods

$(t-1)$ and t, understood as an effect of the change in the structure of the labour factor from the point of view of different labour types' shares l (in KLEMS accounts there are 18 types of labour by sexes, three age groups, and three education attainment levels), calculated residually by subtracting the growth rate of hours worked in the given industry between these two discrete time periods, i.e. $\Delta \ln H_{jt}$, from the sum of weighted contributions to labour factor growth of different labour types, i.e. $\bar{v}_{l,jt}\Delta lnH_{ljt}$ in industry j. ΔlnH_{ljt} are the relative growth rates of the number of hours worked in industry j between two discrete time periods (*t-1*) and *t* for different labour types *l*, whereas $\bar{v}_{l,jt}$ are average shares of labour types *l* in labour compensation of industry j between two discrete time periods (*t-1*) and *t*. In this way the traditionally understood (following R. Solow) contribution of the labour factor to GVA growth as the contribution of hours worked is complemented by the contribution of labour composition, that was not extracted before from the Solow's residual.

This analysis of the labour factor can be furthered, however. The contribution of hours worked in formula (1) can be decomposed by changing this formula into:

$$\overline{w}_{jt}^{L}\Delta \ln L_{jt} = \overline{w}_{jt}^{L}\Delta \ln LC_{jt} + \overline{w}_{jt}^{L}\Delta \ln M_{jt} + \overline{w}_{jt}^{L}\Delta lnH_{Mjt} \quad (3)$$

where:

$$\Delta \ln H_{Mjt} = \Delta \ln H_{jt} - \Delta lnM_{jt} \quad (4)$$

In the above-mentioned formulae $\Delta \ln H_{Mjt}$ is the relative growth rate of hours worked per employee in industry j between two discrete time periods $(t-1)$ and t, calculated residually by subtracting the relative growth rate of the number of employees, i.e. ΔlnM_{jt}, from the relative growth rate of hours worked, i.e. $\Delta \ln H_{jt}$ in industry j. This technique of residual calculations is the reason why the formulae (1) and (3) are always met.

The analysis of the labour factor can also be extended. If the contribution (to GVA growth rate) of labour services (L) is subtracted from the contribution of labour compensation (LR) then we receive the contribution of the change in the relative level of remunerations (SC) according to the following formula:

$$\overline{w}_{jt}^{L}\Delta \ln SC_{jt} = \overline{w}_{jt}^{L}\Delta \ln LR_{jt} - \overline{w}_{jt}^{L}\Delta \ln L_{jt} \quad (5)$$

In such a case, the contributions of all the above-mentioned entities related with the labour factor can be joined in a single formula:

$$\overline{w}_{jt}^{L}\Delta \ln LR_{jt} = \overline{w}_{jt}^{L}\Delta \ln SC_{jt} + \overline{w}_{jt}^{L}\Delta \ln LC_{jt} + \overline{w}_{jt}^{L}\Delta \ln M_{jt} + \overline{w}_{jt}^{L}\Delta lnH_{Mjt} \quad (6)$$

In the KLEMS accounting labour composition LC is interpreted as the main manifestation of labour efficiency in the long run[1], which only to some degree translates into the actual remunerations' level, because wages are to some degree inflexible in the short run. The remaining remunerations' level change SC can be attributed to the actual labour usage that mostly can be related with the business cycle (although, this residually calculated component of labour remuneration level change can also be impacted by all sorts of other 'factors' such as labour factor flows to activities with higher remunerations, individual industry crises related to missing and expensive resources, interactions with the capital factor, i.e. the availability of the capital for labour against the availability of labour for the capital[2], etc.).

The above-mentioned furthering and extension of the analysis of the labour factor allows to study the phenomenon of labour conservation (otherwise labour hoarding), thanks to a simultaneous observation of the number of employees, of the number of hours worked per employee, and of the change in the relative level of remunerations.

For clarity, the Excel tables concerning this developed decomposition of the labour factor contribution are presented in a hierarchical way following the equation (6) being divided into three equations:

$$
\begin{aligned}
\bar{w}_{jt}^{L}\Delta\, ln\, LR_{jt} &= \bar{w}_{jt}^{L}\Delta\, ln\, SC_{jt} + \bar{w}_{jt}^{L}\Delta\, ln\, L_{jt} \\
\bar{w}_{jt}^{L}\Delta\, ln\, L_{jt} &= \bar{w}_{jt}^{L}\Delta\, ln\, LC_{jt} + \bar{w}_{jt}^{L}\Delta\, ln\, H_{jt} \qquad (7) \\
\bar{w}_{jt}^{L}\Delta\, ln\, H_{jt} &= \bar{w}_{jt}^{L}\Delta\, ln\, M_{jt} + \bar{w}_{jt}^{L}\Delta\, ln\, H_{Mjt}
\end{aligned}
$$

that represent the three stages of the labour factor decomposition.

Similarly, to data presentation of the fundamental GVA growth decomposition, the data for the additional decomposition of labour factor contribution to GVA growth are presented, for total Polish economy and by voivodship, as contributions to aggregate GVA growth rate (Excel table marked by E – aggregated contributions are sums of contributions at lower aggregations) or as contributions to industry GVA growth rates (Excel tables marked by E' – all aggregations are computed independently).

[1] The neoclassical premise is that labour is being remunerated according to its marginal productivity.
[2] It is about the income division between labour and capital arising from their relative bargaining powers (that to some degree can arise from social regulations).