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Human capital devaluation modeling[1]

Abstract

The article proposes an approach to the estimation of human capital stock, taking into account the peculiarities of its devaluation. According to the calculations the new human capital put into operation still compensates its devaluation. However a shortage of new human capital put into operation is expected in the near future. This is caused both by lack of human capital investments and by demographic problems in Russia. The current migration policy does not help to solve the problem either.

Keywords: human capital, moral deterioration, physical deterioration, degradation of human capital, demography, aging population

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Моделирование обесценивания человеческого капитала

Аннотация

В исследовании приводится анализ динамики человеческого капитала в России с применением предложенных в статье подходов к моделированию процесса его обесценивания. Согласно проведенным расчетам на текущий момент новый формирующийся человеческий капитал пока еще компенсирует его обесценивание. Однако по оценкам автора уже в ближайшем будущем ожидается недостаток нового введенного в действие человеческого капитала. Это вызвано как низкими затратами на человеческий капитал, так и демографическими проблемами в России, включающими в себя снижение рождаемости и рост доли нетрудоспособного населения, а также неэффективной миграционной политикой.

Ключевые слова: человеческий капитал, моральный износ, физический износ, обесценение человеческого капитала, демография, старение населения

Accumulated human capital (HC) is going down in the value over time. Its devaluation can be sudden and instantaneous (as for example, it happened in the 1990s [Капелюшников, 2008]). However, much more often the process of human capital devaluation is associated with the gradual obsolescence of knowledge and loss of labor productivity [Асланов, 2010; Матершева, 2016].

Taking into account the fact that HC consists of rather heterogeneous elements, it is obvious that the process of its deterioration is not the same as it happens with fixed assets. In this paper we will try to identify these features and fit them into economic models. Our goal is to analyze the dynamics of human capital in Russia, applying different methods of modeling the process of its devaluation.

[1] Работа выполнена по плану НИР ИЭОПП СО РАН, проект 5.6.6.4. (0260–2021–0008) «Методы и модели обоснования стратегии развития экономики России в условиях меняющейся макроэкономической реальности»

The volume of accumulated HC is estimated as follows:

$$HC(t) = BH(t) + HC(t-1) - D(t), \quad (1)$$

where BH(t) is the input of HC in value terms in the year t, HC(t-1) is the residual value of the accumulated HC in the year (t-1), D(t) is the retirement of HC in the year t.

Withdrawal of HC in the model is understood as the retirement of workers of the respective ages, which is reflected in the model as the formation of the residual value of HC(t-1) by its correction for the value of withdrawal D(t). D(t) can be modeled in different ways. In the existing version of the Dynamic Input-Output model with HC it is done similarly to the modeling of fixed capital retirement in the form of reduction in the value of accumulated HC in the past periods in proportion to the constant coefficient of retirement k. Thus, we can rewrite (1) as follows:

$$HC(t) = BH(t) + HC(t-1) \cdot (1-k). \quad (2)$$

It is important to note that, although theoretically the withdrawal of HC in the model is tied to retirement, in fact a partial reduction in its value (depreciation) can take place without its physical withdrawal from the economic system. Moreover, these processes do not occur simultaneously: knowledge, skills become obsolete during the entire work experience, their real value gradually decreases, but the actual exit of a person from the economic system occurs only at the end of his working career. This gradualism is not reflected in the model and the retirement of the HC is modeled as a one-time act.

Knowledge and skills probably do not depreciate as evenly as in (2). So studies show [Асланов, 2010; Матершева, 2016; Melianova et al., 2020] that in the first 10-20 years of work experience, depending on initial abilities, received professional training, favorability of the environment, human capital formed by education expenses not only does not depreciate, but also continues to accumulate in the form of experience, without additional investments in education. But by the end of the second decade of labor activity, as a rule, the rate of depreciation of knowledge exceeds the specified possibilities of their accumulation.

Accumulation of human capital formed by education expenses without additional investments occurs not automatically, but only under condition of practical use of knowledge, acquisition of additional experience. Otherwise human capital formed by education expenses will depreciate with high intensity [Dinerstein et al., 2020; Тетеринец, 2022]. In addition, there can be breaks in a person's career, including for family reasons, which also lead to devaluation of the accumulated HC [Görlich, Grip, 2009; Матершева, 2016].

In the case of human capital formed by health and culture expenses it is much more difficult to identify any general patterns in the process of devaluation, given the huge diversity of HC carriers. The intensity of human capital formed by health expenses devaluation strongly depends on the initial psychophysical characteristics of the person. But this intensity certainly increases with age, which can be considered as a macro-level trend.

One of the possible modeling options, allowing to take into account the above features of HC devaluation, can be carried out with the help of S-curve. As an example, the dynamics of the aggregate HC, described by the crude formula (1), can be modeled more finely with the following model:

$$HC(t) = BH(t) + \sum_{i=0}^{t-1} \frac{BH(i)}{1 + bc^{-(t-i)}}, \quad (3)$$

where the HC put into operation in year t=0 (BH(0)) is equal to the starting value of the accumulated HC(0), calculated by the continuous inventory method.

The application of the S-curve will probably more accurately describe the process of depreciation of the aggregate HC observed in practice, which is characterized by different intensity of the loss of HC value during the life cycle of different age cohorts of workers.

In the Figure 1 there are some results of HC estimation applying the two models described above: with proportional depreciation (with a constant coefficient k) (2) and by applying a series of S-curves (3). Up to 2020, the estimation of the HC dynamics obtained on the basis of available data. Starting from 2021 (dotted line) a hypothetical situation is shown, when there is no more new human capital put into operation and the previously accumulated HC begins to depreciate gradually according to the selected models.

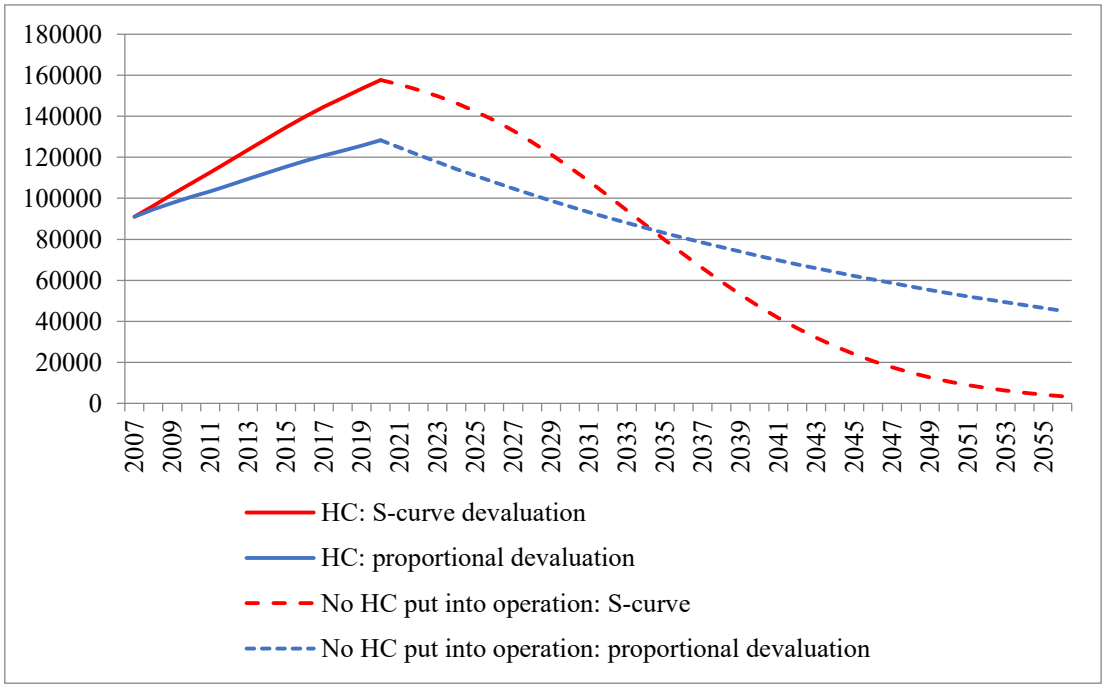

Fig. 1. Dynamics of accumulated human capital with different variants of modeling depreciation in 2007-2055, billion rubles in 2019 prices.

In both models we can see that in the period from 2007 to 2020 HC put into operation still overlaps its devaluation, and, consequently, the accumulated HC grows.

In the case of the logistic curve, the growth rate of HC is higher at the beginning of the analyzed period (so that the average HC devaluation is quite low), but starting from 2016 it begins to slow down. The further it goes, the stronger is the lack of new HC to compensate its devaluation. Given the speed of modern technological change, actual depreciation will occur even faster than shown in both models, and the problem of a shortage of HC put into operation will be even more critical.

Due to the high share of employed people of retirement age, a declining wave of fertility and population outflow, the problem of insufficient compensation for the depreciating human capital may sharply worsen as early as on the 10-15-year horizon. That is why today it is important to shape as thoughtfully as possible demographic and migration programs to level out negative trends affecting the accumulation of human capital.

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Features of modeling intersectoral relations in the economy of a peripheral region on the example of the Republic of Tyva[1]

Abstract

The report shows the specifics of the work on the construction of regional input-output tables on the example of the Republic of Tyva. A detailed description of the most complex, missing in statistics, information arrays necessary for the construction of regional input-output tables is given. Regional peculiarities of the Republic of Tyva, in terms of energy, transport, services and public administration, affecting the formation of the structure of intermediate consumption in these sectors of the economy are presented. The conclusion is made about the limited possibilities of using regional input-output tables to assess multiplicative effects due to short intersectoral relations.

Keywords: regional input-output tables, intersectoral models, small economies, aggregation and granularity, economic forecasting.

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Особенности моделирования межотраслевых связей в экономике периферийного региона на примере Республики Тыва

Аннотация

В докладе показана специфика работ по построению региональных таблиц «затраты-выпуск» на примере Республики Тыва. Дано подробное описание наиболее сложных, отсутствующих в статистике, информационных массивов, необходимых для построения региональных таблиц «затраты-выпуск». Представлены региональные особенности Республики Тыва, в части энергетики, транспорта, услуг и государственного управления, влияющие на формирование структуры промежуточного потребления в этих отраслях экономики. Делается вывод об ограниченности возможностей использования региональных

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