Measuring Human Capital Comprehensively:

Time-Based Measuring for Human Capital Accounting (TBM-HCA)

Overview of Methodology

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1. Measuring Human Capital Comprehensively - Introduction

This overview explains some background, methodological considerations, assumptions and data sets employed in order to create the human capital accounting tool that is used by the Lisbon Council asbl in its human capital research and publications. We call it TBM-HCA – **T**ime-**b**ased **M**easurement **H**uman **C**apital **A**ccounting – because its distinguishing characteristic is to be estimating the total *Human Capital Stock* of a nation or a company primarily by measuring the **total amount of time** that was spent creating it.

As intuitive as the link between investment in people and economic performance appears, it is difficult to prove empirically and consistently. Human capital is created in different ways. To measure it comprehensively requires consideration, *inter alia*, of people's generic and specific skills, formal educational attainment, adult learning and work practices. Quantifiable translations are also problematic. For instance: How much learning-on-the-job is needed to substitute for a month of formal adult education ? What is more effective in generating human capital: spending to reduce the student teacher ratio for immigrant children or spending on retraining the unemployed ? Measurement is further complicated by the fact that different sorts of investment in human capital have different rates of return for different stakeholders (e.g. the individual and society) as well as widely diverging pay-back periods. If human capital and its impacts were more readily quantified, human capital investment might play a bigger role in economic decision making.

This paper describes a Human Capital Accounting model that uses time-based measurements for quantifying economically relevant human capital. The methodology has the following characteristics:

- **Comprehensiveness:** the model captures those four different types of learning which the Lisbon Council research has found to be relevant: a) parental and social peer group education received; b) primary and secondary schooling received; c) tertiary and vocational education received; d) adult informal, non-formal and on the job learning conducted
- **Consistency across type, time and country**: The investment in each type of learning is expressed in the same unit – purchasing power parity US dollars (PPP$) - such that the economic value of all learning is comparable across time and place
- **Allows for depreciation**: Based on empirical evidence of rates of forgetting and rates of knowledge obsolescence, the model depreciates different human capital investments over different periods of time and at different rates.
- **Accounts for input costs**: The value of the investment in learning is primarily measured by the effective time spent on learning. For that we are using a layered model, whereby every learning that happens accelerates the effectiveness of later learnings. Furthermore, early learning does not get depreciated as fast as later learning. This gives early learning a higher indirect value with long-run effects, and later learning a higher immediate direct value with short-run effects.

2. Economic Theory Underpinning the TBM-HCA

TBM-HCA is built on the basis of a branch of economic theory which traces its roots to Adam Smith, who laid down the key principles of the role of human capital in the creation of economic wealth and economic growth. For a fairly complete overview of the scientific debate leading to and surrounding the concept of endogeneous technology-led economic growth based on human capital input we refer to the pages 175-186 of the EU-European Report on Employment published in 2006. It is a comprehensive overview of the scientific debate that is refreshingly void of Greek.

The starting point for human capital studies is typically Gary Becker's theories on human capital, which he introduced in 1964 suggesting that besides the traditional factors of physical capital and labor, there must also be an education element that promotes economic development. Mincer in 1974 attempted to operationalize this theory by relating real wages to years of schooling and years of labor market experience. This empirical analysis triggered decades' worth of studies for rates of return analysis for additional years of schooling. In the course of these studies it could largely be proven that it is the learning that happens in education which leads to higher wages, rather than education being merely a signalling device.

In a macroeconomic context Mankiw, Romer and Weil in 1992 (MRW) developed the so-called "augmented Solow model" of a neoclassical production function, in which human capital is accorded a distinct role of input towards production. In the MRW models technological progress is still an exogeneous factor to the growth equation. Extensive testing of the MRW models revealed inconclusive results, leading to criticisms and alternative variations of the model. Other key authors are Lucas, Grossman and Helpman, or Aghion and Howitt, who tried to link human capital stock and human capital growth to economic growth via the route of technological progress, thereby making technology an endogeneous function of human capital endowment. Gundlach in 2002 was able to show how for 23 OECD countries technology would be endogeneous. From a different angle, authors such as Nelson and Phelps in 1966 and Schultz in 1975 pointed out the role of education in the dissemination and adoption of technological process. More recently a study conducted by Coulombe, Trembley and Marchand in 2004 showed how human capital stock could be estimated on the basis of adult literacy scores.

While our TBM-HCA is building on these economic theory considerations – it is actually aiming at a different purpose: first and foremost it is an accounting exercise – attempting to quantify the amount of human capital that exists in a society or a region in a currency comparable across time, place and kind of human capital creation. Using such an accounting tool for answering macroeconomic growth estimations is but only one of several potential applications. It could also be used to guide questions of education policy and knowledge investments, or contributing to the explanation of innovation dynamics – and several more. In each of such applications, it will have different strengths and weaknesses and should not be seen as a universal catch-all tool for explaining the world.

3. Conceptual Considerations for TBM-HCA

3.1. Fundamental Premises

Time-Based Measurement for Human Capital Accounting (TBM-HCA) assumes the fundamental premise that time is just as much an economic resource as money (which is only a currency denomination for goods that are available for disposal). Both these resources, time or money (goods), can be either invested for higher gains in the future, or they can be used up for current consumption. If they are invested for gains in the future, then they become capital, which economically speaking can be seen as the accumulated amount of delayed consumption. Where such capital is machinery and equipment paid for with financial resources, it becomes financial capital. Where such capital is knowledge and skills created through time spent on learning, it becomes human capital.

Furthermore, TBM-HCA assumes that time and money are freely interchangeable with each other – that means time can be spent to earn money, and money can be spent to buy somebody's time. This is nothing else than the assumption that labor markets are just that: free markets between buyers and sellers, where time and money becomes exchanged for each other. We call this the *arbitrage function* of markets to be trading off investment and consumption decisions between various kinds of financial and human capitals.

By the same token, if money and time are interchangeable economic resources in a free market, they also have the same nominal value when being invested for higher gains in the future. By extension, these two economic resources should be yielding the same risk-adjusted rate of return to the respective investors. That means, actually observed rates of return may be different, but after being adjusted for their perceived riskiness by the investor, they should have the same value to the investor.

The upshot of all these fundamental premises is that both time for consumption as well as time invested in learning knowledge and skills can be monetized in the same single economic currency as the currency in which financial capital is being expressed, ie. for instance in purchasing power parity US Dollars.

3.2. Illustration of the Fundamental Premises

The fundamental premises shall be illustrated with two schematic examples:

Example 1:

Assuming an employer has a choice for increasing the output of an employee by 10%:
Choice A) Investing in a higher grade computer, costing € 1.000

Choice B) Investing in a specific skills training course of his employee at the cost of € 500

Clearly, the employer will opt for choice B, and invest in the skills, i.e. the human capital of his employee. However, the next year, raising the output even further requires even more sophisticated work procedures, for which training would cost € 800. Given the choice between a 1000 Euro computer and an € 800 training, the employer will again opt for the training. Following the law of decreasing marginal returns on investment, in the third year, the training for an even more sophisticated work procedure will cost € 1100. This time the employer will opt for the financial capital investment of buying a new computer.

In this way, both stocks of capital – financial and human – compete with each other for increased investment and by implication can be expected to yield the same risk-adjusted rate of return.

Example 2:

In this example it is not the employer, but the employee who invests in his human capital stock. Knowing that his employer wishes to increase output, the employee invests his own free personal time to upgrade his job relevant skills. The employer rewards such efforts with a higher salary, if the improved skills of the employee yield the desired increase in output. The employer will increase salary only to the degree that it would be cheaper to do that than buying a computer, or investing in training of the employee at the employer's expense. On the other hand, the employer must increase salary enough for the employee to find it commensurately attractive to invest his own personal time.

Example 2 illustrates how time investment in learning competes with financial capital for expectations of higher gains in the future.

Since each of these investment choices compete with each other for investment returns in what is assumed to be an equilibrium market, they can be seen to be yielding the same risk-adjusted rate of returns (arbitrage) – which means by implication that their capital stock must have been equally costly to acquire.

In case of financial capital, the cost of its acquisition is easily monetized, namely the cash cost of purchasing the equipment (which is nothing else than the opportunity cost of investing this cash rather than using it for current consumption). In the case of an employer's decision to spend cash on a training, the resultant human capital stock can also be easily monetized in terms of that cash expense. However, for both the opportunity cost of the employee's time not working for the employer if the latter is paying his salary, or for the personal time spent by the employee learning if he is doing so it on his own initiative, there is no cash flowing and thus no easily observable candidate for monetization.

Nonetheless, it can be assumed that both the employer and the employee as economic actors are making a rational investment choice: The employee can spend his time in either earning money or enjoying life on the basis of his existing human capital, or invest this time into acquisition of more human capital, and thus derive more income and enjoyment (assumedly) later. In this way, the cost of the time spent can be monetized as the opportunity cost of net income that would otherwise be earnable.

In this way, all three investments, explicit cash spent on equipment, explicit cash spent on skill acquisition, and the opportunity cost of the time spent on skill acquisition – become comparable with each other in the same monetized terms.

Monetization of these three types of capital does not change their nature – it is merely a way of describing them consistently in a unit of currency, and thereby making them easier to compare in economic terms.

3.3. Monetization is tied to the respective markets

It is important to note, that those three investments from the previous examples are only comparable to each other through the investment return arbitrage function within their respective markets. For instance the monetary cost of the numeracy skills that a Portugese employee may have acquired in the 1970's is only comparable to the financial capital investments of those years in Portugal. The exact same numeracy skills will have a higher monetary cost in Sweden of the 70's, not because they are different there, but because there they compete against and are rewarded by a higher endowment with other capitals due to the fact that Sweden was a richer country at that time.

At first sight the higher valuation of skills in dependence on the richness of the economic environment appears "unfair" to what in the end remains the same skill. However, from an economic point of view this is correct. "Value" is determined neither by the seller alone, nor the buyer alone, but by the market interaction between both. The value, as much as the cost, of human capital is dependent on its economic environment, much in the same way as the value of a piece of machinery equipment is dependent on its economic environment. If the capital endowment of the economic environment is poor, then investing highly sophisticated machinery may not be worth it, and instead human capital be employed. The investment arbitrage between the different types of capitals still holds true.

Thus the fact that richer countries are automatically endowed with higher human capital stocks is not necessarily a priori a reflection of the fact that they are smarter or more skilled – it may only state that the same skills were more costly to acquire in a richer environment.

By the same token, the economic reality is that if these skills were more costly to acquire and therefore demand higher returns in terms of higher salaries, then they better also turn out to be of higher quality in one way or the other to their economic environment. Otherwise, if they consistently fail to do so, then rational investors of financial capital will invest in better equipment instead – or invest in places where the same human skills can be had for lesser cost. In the short to medium term, there is of course significant stickiness in this arbitrage function, since there are high transaction costs and considerations of installed base when investing in different markets or far away places.

However, if arbitrage opportunities exist, capital will eventually flow to the "relatively lower cost human capital" country, which will then eventually catch up to the previously "relatively higher cost human capital" country. Again, the underpinning assumption to this entire logic of human capital accounting are open markets where all capitals ultimately compete freely against each other. The fact that this free competition might be somewhat inhibited in the short run due to various factors of stickiness in the adjustment of markets, does not invalidate the fundamental logic.

Furthermore, by the same token, the same logic is also true for a comparison of numeracy skills over time – the same skills in Portugal of the 90's are more costly and more valuable in a Portugal of the 70's.

3.4. Accounting with Replacement Cost Logic

From the above logic of the nominal monetary value of investments being dependent on the overall wealth of the economic environment, follows as well that all net available skills in the human capital stock must be revalued if the surrounding environment grows richer. The same is often done in financial accounting for company's assets, when equipment is valued at its "*replacement cost*", rather than at its historical "*investment cost*" in order to account for its growing value due to surrounding wealth increase.

Therefore in TBM-HCA all human capital stock is monetized in the currency values of each respective years and countries based on replacement cost consideration. For instance, the time of schooling education that a 40 year old had received in 1970, is revalued (after depreciation of forgetting and obsolescence) in the year 2000 at the rates that it would have cost to receive this education in the year 2000. In this way the economic costs of all types of educations remain consistently comparable across time and place – and always remain subject to the same investment arbitrage principle.

3.5. Educational Pathway Biographies

Due to our layered model of skill acquisition where earlier learning impacts the effectiveness of later learning it is necessary to construct representative learning

biographies. We are currently modelling twelve such representative "biographical pathways", where we differentiate between two levels of parental/social peer group learning, three levels of secondary school learning, two levels of tertiary/vocational learning, three levels of on-the-job/informal learning and two levels of immigration status.

In our database model we aim to have every member of a society or an organisation (like a company) modelled along these five filters, and thus be able to account for each member of society/organisation at each year how much learning has accumulated. Subsequently we determine the employment utilization for each of these biographical pathways, so that we then know how much of this learning is being actively contributed to the economic system of society. By totalling up each member of society/organisation that we have such assessed, we then know the total amount of learning – or rather the total human capital stock – that is in active economic use in that society or company.

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