

A PHYSICAL BASIS OF ECONOMICS

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Economics in the beginning of civilization

Professor Denise Schmandt-Besserat discovered tokens and analyzed the development of the power of abstraction as illustrated by the evolution of counting in the ancient Near East. She examined a large number of small clay artifacts of various shapes which she refers to as “tokens”. Research made by D. Schmandt-Besserat [2007, p 51-93, 2013] has shed much light on the origin of writing and counting as well as labor accounting. Plain tokens appear from ca. 8000 B.C. Photo 1 presents various tokens from Mesopotamia (Iraq), ca. 4000 B.C. The cone, spheres and disk represented various measures of grain; the tetrahedron stood for a unit of labor. This token (tetrahedron) is the most intriguing. It was a common view that the clay tokens only abstracted the goods they represented but the pyramid-shaped token represents pure abstract category of labor unit.

Photo 1. Different clay tokens



Source: Courtesy Denise Schmandt-Besserat, University of Texas at Austin. Schmandt-Besserat D., (2007, p. 3), *When Writing Met Art. From Symbol to Story*, University of Texas Press.

The great work of discovering tokens helped explain the emergence of numeracy skills and the use of pictographic writing as well the development of humanity's cognitive skills. From an economic point of view, the importance of discovering tokens is much broader since they point to an existence a coherent labor-based economic system. Therefore for our purposes we shall pay special attention to the token shaped as the tetrahedron representing the unit of labor. It is an amazing paradox that from the beginning of civilization a unit of labor has emerged naturally, which in today's economic theory does not seem to be needed for anything.

This early economic system is driven by triad of the three categories [Dobija, Śliwa, 2001], [Dobija, 2007]. The first is a work but the work must have its source, that is to say an accumulated ability to perform labor. Therefore, a category of capital appears as the potential to do the job. This is the second factor. Products manufactured must be distributed to employees in consistency to their value of work. This category “value of contributed work” determines work receivable for the workers. So the triad is composed as: human capital – work – work receivable. Economic process runs as follows. The worker has human capital, so he/she can perform the work. After work is done he/she receives a confirmation (pyramid-shaped tokens) stating the amount due (work receivables in labor units). Of course, the sphere representing some measure of barley is equivalent to a certain number of units of work. Finally, he/she

exchanges tokens for suitable products. Thus, tokens and this one distinguished as the unit of labor could be a convenient tool for conducting this early economic system.

As R. Mattessich [2000, p 4-5] explains, the clay tokens in hands of their owners or managing administration were preserved in fired clay envelopes (hollow clay balls). The natural interpretation indicates that the person performing the work on the instructions of the managers received tokens representing the value of the work done, i.e. the tokens represented amounts due for work. To obtain the necessary livelihoods, tokens were exchanged for products such as: barley, olive oil, etc. In the current system it is similar; we work, in return we receive a record of the amount due for work on the bank account, and then we exchange our receivables for the necessary products. So the work creates our money and this is the basic physical fact in economics.

How was the value of work measured?

The natural basis for measuring work and its value is to compare the possibilities and productivity of workers. This is how it is now and it has been so from the very beginning. According to archaeological evidence and interpretations of clay tablets containing records of labor performed by different group of workers, an economic system driven by labor already existed in the 3rd millennia B. C. V. Struve [1969, p 127-172], who examined organization of labor in Sumer (documents from the archives of Lagasz and Umma), claims:

The time assigned for the performance of each labor operation is sometimes estimated in days, and sometimes in months; but in the majority of cases it is given as one day: (so many laborers for one day). The meaning of this formula occurring in these small documents, which I called primary, was fully revealed as a result of comparative analysis of the large reports of the overseer compiled on the basis of the primary documents, recording work performed by the laborers of their gang during a certain period. (. . .) In addition to the unit of labor force, the scribes distinguished such quantities as 5/6, 2/3, 1/2 etc. of a unit of labor force. The laborer whose productivity of labor was estimated at 5/6, 2/3, 1/2 etc. of a unit of labor force, received grain ratios proportionately reduced.

Fractions 5/6, 2/3, 1/2 etc. apparently determine the employee's power, so we come across a natural formula for measuring work, namely: $L = \text{power} \times \text{time}$, where L - work value. Here factor $\cos \alpha$ is skipped since labor of workers was under control of overseer so $\cos \alpha$ was equal to 1.0. The formula for measuring work, applied in physics, presented in a simplified scalar notation (without vectors) shows two equivalent models. In this simplified scalar description, the measure of labor is:

$$L = F \times s \times \cos \varphi = F \times v \times t \times \cos \varphi = P \times t \times \cos \varphi \quad (1)$$

Where L = scalar mechanical work; F = scalar force; v = speed scalar; $\cos \varphi$ = cosine of the angle between direction of force and direction of movement; P = scalar of power; and t = time of completion of work.

Now, in case of human work, we apply knowledge about measuring human capital, and the formula (1) is reshaped as follows:

$$L = P \times t \times \cos \varphi = H_e / H_{\max} \times t \times \cos \varphi \quad (2)$$

Where: H_e is value of an employee human capital; $H_{\max}$ is value of capital representing the individual with maximum skills.

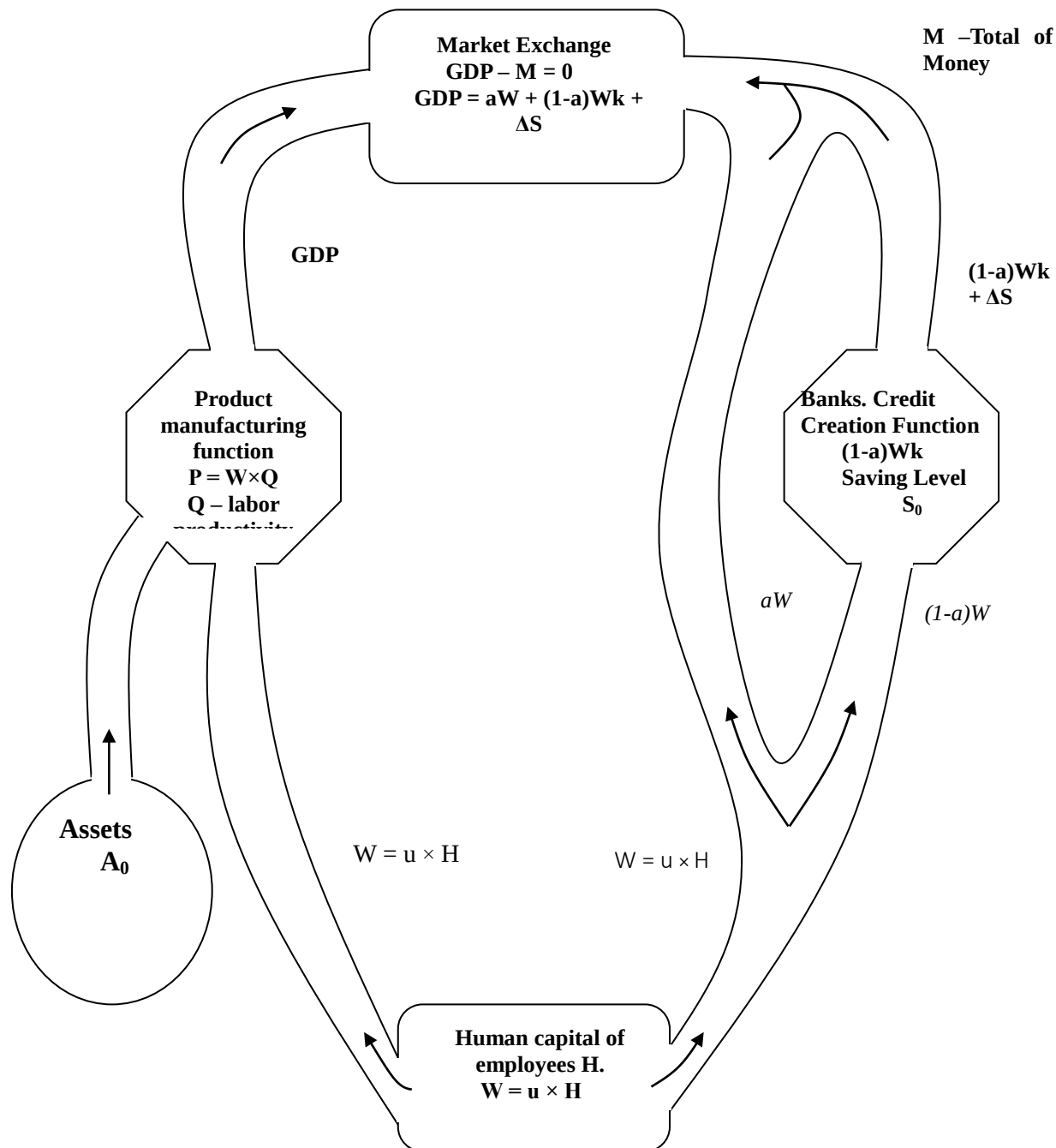
Thus, the product of power and time of work was and is a universal measure of the value of work. This formula is also widely used today. If the professor's earnings are, say USD80,000 and the professor assistant earns USD40,000 per month, then the coefficient of power is 1 and 1/2 respectively. 200 hours of assistant work is as 100 professor's hours.

The equation of exchange

The essence of the money-goods economy is the exchange of remuneration for work for products of labor. So economy is a continuous market confrontation of two streams, which are activated by the potential of human capital and labor, as it is shown in diagram 1. The first stream (left side) forms value

of final products generated by composition of the labor cost of employees measured by wages (W), and the past work embodied in different sorts of assets (A). The second stream shows wages (W), perceived as work receivables. The source of these two streams is human capital of employees and transfers called labor, and their edge is the market exchange of money (work receivables) to products. This exchange can be described in the form of the equation of exchange. The streams run constantly, but to capture the quantitative relations, we use variables in the annual scale, in particular of the GDP category.

Diagram 1. Market as a mechanism leveling the value of product and money



Source: Dobija, M. (2011) Abstract Nature of Money and the Modern Equation of Exchange, *Modern Economy*, Vol. 2, No. 2. 142-152.

Let us notice that diagram 1 encompasses the work of every employee: farmer, worker, teacher or police officer who works both in the private and the public sector of economy. The wage equation of exchange

balances the value of GDP with the sum of money M. According to the diagram 1, this equation is as follows:

$$\mathbf{GDP = GDPR(1 + i) = a \times W + (1 - a) \times W \times k + \Delta S} \quad (3)$$

Symbols denotes as follows: GDP – nominal GDP, GDPR – real GDP, W – labor costs, Q = GDP/W – work productivity index, Q_r = GDPR/W – real work productivity index, i – inflation (deflation) rate, a – variable of poverty or prosperity, k – coefficient increasing the value of stream W(1 - a) as a result of credit actions conducted by commercial banks, ΔS change in saving level.

Assuming that i = 0 and dividing equation (3) by W we obtain useful formulas (4) and (5) for computing coefficient k and adequate credit level (C):

$$\mathbf{Q = Q_r = a + (1 - a) \times k + d, \text{ where } d = \Delta S/W} \quad (4)$$

$$\mathbf{Credit = W \times (Q_r - a - d)} \quad (5)$$

In a primitive economy where GDP = W, the Q = 1, a = 1, and ΔS = 0 there is not a possibility of credit creation. A required level of credit is determined mainly by the real productivity of labor.

What if physical knowledge were consistently applied?

The natural source of economic processes is the potential for ability to act (capital), embodied in assets and human resources. This is the source of the labor that drives economics running product and money streams [Dobija, 2015]. As a consequence, there are natural properties of economics such as the fact that work finances itself, so no taxes are needed with the exception of financing purchases of assets for government entities. In the current system, the budgetary sphere is financed by taxes, which reduces the natural flow in the stream of money (diagram 1). This condition causes imbalances, such as deflation or inflation, depending on how much money the FED generates. What is equally important is the country is still indebted and the interest is still accruing.

In the natural economy, the central bank must act as a payer of remuneration for government unit's employees and as the labor productivity controller. To be the payer means to record work receivables on employees' bank accounts. There is no money printing. Money arises naturally as records of receivables for performing productive work. Not just government employees but also mothers raising children are also doing such work. Productivity control is based on preventing the ratio Q = GDP/W from falling, which currently exceeds slightly 4.0 in the US. This indicator cannot decrease and the good situation is when it increases slightly. Control of productivity ratio also limits the size of the budget sphere to the right size. Credit is necessary in the economy to maintain stability in the value of money. The forces of nature (photosynthesis in agriculture) operate in the production stream, so the value increases beyond the costs incurred. This increase balances the credit generated by commercial banks in the stream of money. Deflation and destruction of the economy would appear without credit. Natural economy is self-steering.

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