

USE OF ANALYTIC FUNCTIONS OF PRODUCTION IN THE PROCESS OF MOTIVATION OF WAGES

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ABSTRACT

This paper presents a model for determining the remuneration of the bonus, which takes into account the actual participation of the human factor in the process of product development. This model is constructed on the basis of the production function in the form of analysis. This allows to determine the level of wages - understood as an equivalent for the human capital available to the employer's time - depending on the evolution of the various economic values representing the arguments used the production function. In the second part of the article presents a practical example of the calculation of the bonus fund, which is a key element of the incentive system of the company.

Key words: function of production, motivation of wages, economics model, value of bonus fund, productivity

1. Introduction

The main objective of modern management systems is to maximize the effects of the activities and efforts to achieve sustainable economic effects, such as a strong market position, or prestige brand innovation and willingness to take on new business challenges. A key prerequisite for achieving this goal is the efficient use of existing physical and human resources in manufacturing processes. However, the basis for the due performance of economic knowledge is the nature of the product development process and, consequently, a reliable measurement of costs. On the basis of the concept of human capital, the cost can be divided into work understood as the use of human capital, manifested in labor costs and the use of physical capital (physical assets). In the case of the assets can be identified by the standards governing valuation principles wear.

These principles reflect the consensus of scientific and practical subject to regular review and updating. The other hand, is still not clearly solved the problem of fair and accurate assessment of the value of human capital and to determine the appropriate level of compensation for his release.

This article aims to provide a summary of bonus fund formation system in the enterprise. Implementation of the work involves the use of a method based on the concept of analytic functions of production. This function allows the reliable measurement of the scope of participation of employees in the organization's performance. The scope of this participation is a derivative of the level of human capital in the production process. Valuation of human capital to the company's employees used a method based on the concept of an alternative model of human capital.

Determination of the amount of the bonus fund on the basis of data from the standards of financial reporting and human capital account allows company employees primarily on procedures for inclusion in the financial planning and budgeting is also planning bonus fund. The amount of this fund achieved will depend on the size of the economy. The usefulness of the presented method of shaping the bonus fund will depend on the extent to which this method to meet the universal principles of wage motivation. Because only then the bonus system basing on the method used will be an effective incentive for employees to desired organizational behaviors and attitudes.

Modern conceptions of company illustrate the process of creating salaries as a specific system for determining remuneration teamwork for individual members, which creates and stimulates productivity. Moreover, the statement shall be as follows: if the relationship is maintained between inputs and reward the entire team productivity increases (which is, after all, it creates a "pool of remuneration"), if the relationship is casual, this team productivity decreases (Alchian, Demsetz, 1986). The use of analytic functions using the concept of the production of human capital allows to determine the appropriate relationship between effort and reward, which will ensure increased productivity leading to enlarge the already mentioned "pot salaries".

2. The production function in economics

The production process is a creative transformation of the factors of production, aimed at satisfying the needs of product performance and market requirements. For more than two centuries of development economics, numerous models illustrating the process of the use of certain factors of production to produce the product stream. These models are called the production function.

The first researchers conducting research on the issue of the production function confined themselves to take into account two factors of production: labor and land, and the land was identified with all the forces of nature. The pioneering nature of Adam Smith had a concept that has expanded set of arguments for capital production function. In his work on the wealth of nations, presented in the form of the production function: $Y = f(L, K, T)$, where Y means product, L – labor resources, K – capital i T land.

This concept depends on the increase of the product depending on the growth of the human population, capital investment, growth and productivity of the land resource. Introduction by Smith became a category of capital contribution to the discussion on the concept of capital, which in turn led to the spread of this category in the environment economists. As a result, this led to the expansion of the production function arguments about capital. At this point it is worth noting that the labor and land among the scientists are understood as clearly as opposed to the capital, which was and still is interpreted by economists in different ways. Ch. Bliss wrote that economists are able to reach agreement on any matter, if you have previously come to a consensus on the issue of capital (Dobija, D. Dobija 2003).

Breakthrough for the development of the manufacturing process modeling was to develop an econometric model of the production function in the mid-twentieth century by two researchers Cobb and Douglas. The arguments in this function are: capital understood as physical resources and the work indicating the level of employment. The form of this function is as follows: $P = L^{\alpha} \cdot K^{\beta}$ where: L – the level of employment, K – physical

capital stock, α i β – estimating subject to fit a function to empirical data (Romer, 2000).

One of the leading representatives of mainstream neoclassical growth theory R. Solow used the function of the Cobb - Douglas to describe the relationship between the change in the amount of the factors of production (capital and employment) and the volume of production. In addition, enriched Solow model parameter representing the rate of technological progress (Blaug, 2000).

3. The concept of analytic functions of production

The existing achievements in the field of modeling the production function apply only to describe the economic reality at the macroeconomic level, and then mainly the analysis of economic growth or global product. Use of classical economics on the achievements of the production function to optimize the productivity of individual companies, ie at the micro level, it is practically impossible. In modern scientific papers formulated reservations concerning the classical form of the production function, which will help eliminate consideration of their imperfections and expand the possibility of their use in the analysis of the production of individual companies (Dobija, 2004).

Firstly, the barrier to the use of classical models of product development is the valuation of the production function arguments in natural units. As it knows, the economy of commodity - money allows measurement of all factors of production using monetary units. Thus, the production volume modeling requires the presentation of the factors of production, such, for example, as labor costs and the use of materials in a quota. Another drawback of the production function developed by the followers of classical economics is not taking into account the economic nature of the production process. Production in fact results from the summation of inputs, for example, the model and the Cobb - Douglas takes the form of arguments that are multiplied.

Presented analytical production function uses a natural approach based on cost calculation. It presents the production function with seven specified arguments. The analytical form of production function divides operating costs into compensation understood as labour costs (W) and non-compensation costs (K_m) decreased by risk-related costs (K_r). This differentiation introduces the annual asset turnover rate (z), the asset impairment rate (s) and the level of pay for human capital (u). Therefore, the production function equation can be expressed in the following way (Dobija, 2004; Dobija 2012):

$$P = (W + K_m - K_r) \cdot (1 + r) \quad (1)$$

$$\frac{K_m}{A} = z \quad (2)$$

$$\frac{K_r}{A} = s \quad (3)$$

$$K_m = z \cdot A \quad K_r = s \cdot A \quad W = u \cdot H \quad (4)$$

where: K_m – costs resulting from the use of assets, K_r – risk-related costs, W – compensation (labour costs), A – value of assets, H – staff's human capital, u – level of pay for human capital, z – asset turnover to non-labour costs ratio, s – asset impairment in production processes.

The analytical production function corresponds to the actual process of developing products. It describes the composition of production factors in the production process. The market value of products, on the other hand, represents the historical cost of manufacture adjusted to the cost profitability ratio (r). As a result, the system of arguments determines all significant variables, and the basic analytical form of the function, unlike in the case of other popular models, does not require parameter estimations. According to the model, the market value of production can be presented as the function of the sum of outlays. The transformed formula and the inclusion of the company's intellectual capital (I) leads to the extended function:

$$P = (W + z \cdot A - s \cdot A) \cdot (1 + r) \cdot (1+I) \quad (5)$$

where: I – intellectual capital.

The transformed formula for presenting production effect (P) as the function of labour costs results in the following formula:

$$P = W \cdot \left[1 + \frac{A}{W} \cdot (z - s)\right] \cdot (1 + r) \cdot (1 + I) \quad (6)$$

The use of the human capital concept in the analytical production function model allows for expressing labour costs ($W = u \cdot H$) as a derivative of human capital value:

$$P = W \cdot \left[1 + \frac{A}{H} \cdot \frac{z-s}{u}\right] \cdot (1+r) \cdot (1+I) \quad (7)$$

The presented concept is a general form of the cost account and it includes the category of natural loss (s) related to any business activity. Consequently, the model reflects the actual production process, being a useful management tool.

The model facilitates calculation of the actual use of human capital in the production process and an appropriate level of compensation. As a result, the presented methodology for bonus compensation can be a basis for setting up a bonus fund based on a company's adopted bonus system. The level of pay for work (W), i.e. the level of total compensation composed of fixed and variable components, can be presented as follows (Dobija, 2011):

$$W = u H(T) = p H(T) + m H(T) \quad (8)$$

where: u – variable representing actual pay for human capital, p – 8% economic constant of potential growth, m – bonus (%).

Although the amount of a bonus fund is calculated as m -% of a company's human capital value, it is labour productivity and a company's profitability that provide that additional value. The transformation of the analytical function for the purpose of the use of the successive approximation method results in a formula which determines a variable indicating the actual pay for human capital (u) (Koziol et.al, 2014):

$$P = u \left(\frac{L}{p} + \frac{A(z-s)}{u} \right) e^r \quad (9)$$

$$u = \varphi(u) = \frac{P e^{-r}}{\frac{L}{p} + \frac{A(z-s)}{u}} \quad (10)$$

where: L – total value of fixed compensation components.

The numerical solution of the functional equation is based on the use of the iteration algorithm which assumes the existence of one point fulfilling the condition $\varphi(x) = x$. A fixed point can be determined with any small error applying the method of successive iterations and starting with any initial value u_0 . As a result, the fixed point is convergent to sequence: $u, \varphi(u), \varphi(\varphi(u)), \dots$

The use of the successive approximations method allows for estimating the value of variable (u). If the obtained value of the variable which indicates the level of pay for human capital (u) is smaller than or equal to the constant economic value (p), employees do not deserve additional compensation above their base pay. On the other hand, when the value of (u) exceeds the value of an 8% economic constant of potential growth, the amount of a bonus fund is calculated as follows:

$$F = \frac{u-p}{p} L \quad (11)$$

where: F – value of bonus fund.

Table 1 presents the results of calculations based on empirical data over a period of three years collected from Polish medium company. The results are the basis for determining the value of variable (u) as well as the amount of a bonus fund.

Table 1. Calculation results – compensation for work (in PLN thousands)

Financial data:	2006	2007	2008
Sales (P)	136 911	147 000	329 293
Value of assets (A)	68 918	148 225	245 253
Operating costs	129 022	137 400	309 998
Compensation and social benefits (L)	8 955	13 630	19 033
Loss rate (s)	0.02	0.02	0.02
Labour pay variable (u)	9.04%	9.55%	9.83%
Bonus fund (% of base compensation)	13%	19.4%	22.9%
Bonus fund (amount)	1 167	2 646	4 362

Literatures in the area of compensation suggest that a bonus should be a motivating factor, which implies that it should have a positive impact on employee attitudes and behaviours and contribute to achieving company objectives. The impact of bonus pay on employee motivation and, consequently, company performance reflects the effectiveness of the bonus system. The effectiveness of the system is affected by the following factors (Armstrong, 2007):

- results are promptly rewarded,
- systematicity,
- simplicity and transparency of motivation systems,
- close and visible relation between work and its effects.

The possibility of forecasting provided by the production function concept can increase the effectiveness of motivation systems. It facilitates analysing future financial scenarios and setting the level of bonus funds depending on the company's performance. The proper operationalization of financial targets enhances the system for effective pay-related incentives.

Bonus fund as described above should be disposals by management in accordance with the elaborated rules and best practices and reward bonus. The fact that the amount of the bonus fund depends on the developed economic values can be used at the stage of financial planning. The preparation of the financial plan for the next year also allows for the planned amount of bonus fund, which will depend on the scope of the plan. The development of such a plan should also include the expected level of management. This level reflects management variable (Z), which is expressed by the following parameters: asset turnover ratio (z), the core loss of assets (s), the level of pay for human capital (u) and an increase in the cost of the product to the market value (r). Thus, the variable Z can be summarized as follows (Dobija, 2004):

$$Z=F(s,r,z,u) \quad (12)$$

Then the production function takes the form:

$$P=W_e^{(A/H)Z} \quad (13)$$

In view of the above equations variable (Z) describes the degree of rational use of resources involved, and its value is impossible to estimate on the basis of economic data. Thus, knowledge of the management of variable size (Z), and its development over the last few periods, allows the assessment of the quality of business management. Management variable (Z) can also be calculated based on planned economic size, and so on the basis of the budget for the next period. Thus, the production function can be used to analyze future economic enterprise, depending on the level of achievement of expected economic values. For example, how will the increase in production due to the amount of the premium, assuming that the level of management (the value of the variable Z) is constant or how it should develop a management level (Z) to the level of pay bonus has not changed.

As can be seen, the concept of analytic functions of production is not only a tool for sustainable and effective management of the enterprise, but also can be a starting point for the implementation of the concept of corporate social responsibility (CSR) in the company in the area of equitable remuneration. Studies indicate that a broad implementation of CSR practices can contribute to building a long-term competitive advantage of the company (Sahinidis, Kavoura, 2014).

Table 2. (in PLN thousands)

Financial data:	2008	Budget for next year	Budget for next year	Budget for next year
Sales (P)	329 293	340 000	340 000	340 000
Value of assets (A)	245 253	250 000	250 000	250 000
Compensation and social benefits (L)	19 033	19 650	19 650	19 650
Loss rate (s)	0.02	0.02	0.02	0.02
Labour pay variable (u)	9.83%	10.2%	8.94%	8.08%
Bonus fund (% of base compensation)	22.9%	27,5 %	11,8 %	1%
Bonus fund (amount)	4 362	5 407	2 310	191
Management variable	2,57	2,57	2,7	2,8

Table 2 presents projections for the following year. They assume a slight percentage increase in production accompanied by a slight increase in costs and the absence of investments. The value of assets is close to the previous year's level. The amount of the bonus fund will depend on the extent to which the planned level of management. Management level is the result of the organizational efficiency of the board. If the management level increases, indicates a better use of existing resources, including human resources. This means the company commitment to a lower paying job. As a result, an increase in the variable management of 2.57 to 2.7 causes a decrease in the level of pay for work of 10.2% of the value of human capital to 8.94%. What in monetary terms represents a decrease of 5 407 thousand. to 2 310 thousand. PLN. Growth management variable to 2.8 in practice means no bonus fund.

4. Conclusion

As you know, the economy turn of the century is characterized by high dynamics and volatility of the economic environment. Under these conditions, survival and further development of enterprises require to ensure the highest level of efficiency and thus productivity. However, in order to have influence on the level of economic productivity, you need to understand the nature of product development. Therefore, it is necessary to use an production model, which enables it to optimize. Proposed in the article Analytical production function performs the above postulate. Allows you to analyze the many ways of achieving the economic purpose (eg. An adequate level of sales) and the selection of the best of them. An important application of the analytical production function is the ability to determine the synthetic indicator of management, representing the overall level of business management, so deciding on the level of productivity. This index is a valuable tool in the hands of executives, allowing the prediction of the future level of productivity, and therefore, premature to counteract negative trends.

Identification and improve areas of the company, which affect the reduction of productivity, requires an appropriate level of employee engagement. One of the functions of management is to motivate employees to perform the tasks of economic, by shaping the desired attitudes and behavior of employees. Analytical production function allows you to actively take into account the behavioral aspect of the management process, as it allows the company to link remuneration system with its productivity.

References:

- Alchian A., Demsetz H., (1986), Production, Information Costs, and Economic Organization [in:] The Economic Nature of the Firm, Cambridge University Press, Cambridge, pp. 111-135
- Armstrong M., (2007), A Handbook of Employee Reward Management and Practice, pp. 106 - 126
- Blaug M., (1995), Metodologia ekonomii, PWN, Warszawa, p. 459
- Danias A., Kavoura A., (2013), The role of social media as a tool of a company's innovative communication activities, The Małopolska School of Economics in Tarnow Research Papers Collection, vol. 2(23), pp. 75-83
- Dobija D., Dobija M., (2003), O naturze kapitału, Zeszyty Teoretyczne Rachunkowości, Vol. 17 (73), Stowarzyszenie Księgowych w Polsce, Rada Naukowa, Warszawa, pp. 32-41
- Dobija M., (2011), Labor Productivity vs. Minimum Wage Level, Modern Economy, Vol. 02 No. 05
- Dobija M., (2004), Analityczna funkcja produkcji, Ekonomika i Organizacja Przedsiębiorstwa. Vol. 40, vol. 11 (658), pp. 53-45
- Dobija M., (2012), Political Reforms Based on a Human Capital Research Programme, Argumenta Oeconomica Cracoviensia, vol. 8, pp. 45-60
- Kozioł L., Kozioł W., Wojtowicz A., Pyrek R., (2014), An Outline of a Compensation System Based on Human Capital Theory, Procedia-Social and Behavioral Sciences, Elsevier, vol. 148, pp. 551-558.
- Romer D., (2000), Makroekonomia dla zaawansowanych, PWE, Warszawa 2000, p. 27
- Sahinidos A.G., Kavoura A., (2014), Exploring Corporate Social Responsibility practices of Greek companies, Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie, vol. 2 (25).