[6] Mnushko Z.M. Management and marketing in pharmacy: Ч.II. Management in pharmacy: Textbook for university students / Z.M. Mnushko, N.M Dichtyareva; ed. Z.M. Mnushko. − [2nd form.] − Kh.: NFaU "Golden Pages", 2009 − 448 p.
[7] Okhrimenko M.G. Operations Study. Textbook / M.G. Okhrimenko, I.Yu. Dzuban. − K.: Center for Educational Literature, 2006. − 184 p.

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LINKS BETWEEN MANUFACTURING FUNCTIONS ON CONSUMER SERVICE ENTERPRISES

ЗВ'ЯЗОК МІЖ ВИРОБНИЧИМИ ФУНКЦІЯМИ НА ПІДПРИЄМСТВАХ ПОБУТОВОГО ОБСЛУГОВУВАННЯ

Nowadays, the role and place of consumer services enterprises in the processes of modernization and development innovations at the regional level is becoming a topical scientific and practical problem. The role of household services in the economy of Ukraine and its regions, as well as their social significance, is quite important. These enterprises provide the opportunity to create new work places even during the economic crisis, which reduces social tension and the burden on the labour market. The intensive development of consumer services is supported by the growing consumer demand for domestic services, which necessitates the effective management of household services in the strategic aspect. The purpose of the article is to investigate the connection between the production functions of the service sector enterprises. We investigated the functioning of a small enterprise, which consists of two parts: dry cleaning and laundry. Depending on the functioning efficiency of one of the two companies, analytical production functions are built. Using the apparatus of economic-mathematical modelling of investment activity of the enterprise, were analysed the characteristics that affect the dynamics of the enterprise as a whole, on the investment strategy, which reflects the processes of self-financing of the enterprise. The given figures show different models of enterprise development and give an opportunity to analyse economic indicators of the functioning of an enterprise that need to be taken into account when constructing a system of indicators of the efficiency of functioning of enterprises that are involved in the domestic sector. This system should characterize the degree of performance of production and assess the dynamics of the economic effect of attracting additional resources. It is also necessary to ensure a ratio of economic coefficients that are responsible for the investment in such a way that the operation of the enterprise would not be subjected to regression or stagnation, but worked in the optimal mode depending on their own capacities, social needs of the region, etc.

Keywords: economic-mathematical model, production functions, operational calculus, dry cleaning, laundry

В сучасних умовах актуальною науковою і практичною проблемою стає дослідження ролі і місце підприємств побутового обслуговування в процесах модернізації та інновації розвитку на регіональному рівні. Роль підприємств побутового обслуговування в економіці України і її регіонів, а також їх соціальне значення є досить вагомим. Ці підприємства надають можливість створювати нові робочі місця навіть під час економічної кризи, що знижує соціальну напругу і навантаження на ринок праці. Інтенсивному розвитку підприємств побутового обслуговування сприяє зростаючий споживацький попит на побутові послуги, що обумовлює необхідність ефективного управління підприємствами побутового обслуговування в стратегічному аспекті. Метою статті є дослідження зв'язку між виробничими функціями підприємств сфери обслуговування. Розглянуто функціонування малого підприємства, яке складається з двох ланок: хімчистка і пральня. В залежності від ефективності діяльності функціонування одного з двох підприємств аналітично побудовані виробничі функції. Використовуючи апарат економіко-математичного моделювання інвестиційної діяльності підприємства в роботі проаналізовані характеристики, які впливають на динаміку розвитку підприємства в цілому, на стратегію інвестування, яка відображає процеси самофінансування підприємства. Наведені рисунки показують різні моделі розвитку підприємств і дають можливість проаналізувати економічні показники функціонування підприємства що необхідно враховувати при побудові системи показників ефективності функціонування підприємств, які задіяні в побутовому секторі. Ця система повинна характеризувати ступінь результативності виробництва і здійснювати оцінку динаміки економічного ефекту при залученні додаткових ресурсів. Також необхідно забезпечити співвідношення економічних коефіцієнтів, які відповідають за інвестиції таким чином, щоб функціонування підприємства не зазнавало регресії чи стагнації, а працювало в оптимальному режимі в залежності від власних потужностей, соціальних потреб регіону тощо.

Ключові слова: економіко-математична модель, виробничі функції, операційне числення, хімчистка, пральня.

Introduction. Nowadays, the role and place of consumer services enterprises in the processes of modernization and innovations development at the regional level is becoming an important scientific and practical problem. The role of consumer services in the economy of Ukraine and its regions, as well as their social meaning, is quite significant. These enterprises provide the opportunity to create new jobs even during economic crises, which reduces social tension and the burden on the labor market. The intensive development of the household market enterprises is supported by the growing consumer demand for personal services, which leads to the necessary of effective management of household services in the strategic aspect. In general consumer services business has great part of private sector in many developed countries [1]. In the context of the transformation of the Ukrainian social and consumer complex this kind of business needs to seek and choose approaches to evaluate the economic efficiency of its components. The current state of the majority of consumer services companies indicates the need to develop effective mechanisms, schemes, levers and methods for evaluating the effectiveness of its functioning, as the small business sector does not play such an important role in the national economy as in other, economically developed countries [2,3]. But the importance of the activity of consumer services business is

not more or less than the same thing of any business of others directions. As a result of the economic crisis in Ukraine the most affected areas include such services as laundry and dry cleaning, repair shops. The restaurants market, the market for beauty salons and the market of corporate insurance have better situation, the telephony market, the tourism market, the market of advertising and marketing services are stable with minimal loss, and in the state of prosperity there is a market of gas stations services. What is about possibilities of the development of the services sector in Ukraine, it is obvious and logical that it depends on overcoming the economic crisis on time. It also needs additional investments, including foreign ones. Foreign capital can ensure not only the receipt of the necessary financial resources, but also advanced and technically efficient methods of service realization, which will increase their quality, accessibility, service culture and, ultimately, will make better the competitiveness of consumer service providers and Ukraine's position in the international services exchange [4]. Problems of the quality of consumer services (taking the example of dry-cleaning of fur products) were disclosed and criteria for evaluating the quality of services were defined in order to improve the performance of the enterprise in [5]. It has been determined that evaluating the quality of services on each stage (reception, production process and delivery of dry-cleaning products) using Ishikawa and Pareto charts, consumer complaints is a good way of protecting customers' rights. The development of rural territorial communities is studied in [6]. The growth of the European integration level requires the transformation of social & infrastructure potential on the territorial villages' communities' level, which objectively needs a transparent and adapted to world standards model of managing their development. According to the author, the further development of rural communities and the reform of the agrarian sector on a market basis open opportunities for more efficient use of the social and infrastructural potential, they also require the full realization of this potential, as well as achieving social, political and economic stabilization of the country. In [7] a research of the state of the market of consumer services in Ukraine is made (on the example of repair and individual services). The result helps to determine the strategic priorities of the development of the consumer services sector. One of the most promising forms of entrepreneurship, associated with the organization of non-manufacturing services, is the concomitant and network forms that have been used in various kinds of household services. The network model of entrepreneurship enables enterprises not only to withstand competition, but also to create new segments of the household services market. It is the network entrepreneurs who form a modern market of consumer services in Ukraine. Extrapolating the research results in the light of this trend, it is possible to predict the strengthening of the role of network enterprises in the strategic perspective.

Setting objectives. The purpose of this work is to study and to analyze the activity of the service sector enterprises through the use of economics and mathematical models with help of the apparatus of the operating calculus.

Methodology. Using the apparatus of economic-mathematical modeling of the enterprise there are some characteristics, that affect the dynamics of enterprise development and reflect the processes of self-financing of the enterprise, analyzed.

For an analytical solution, the dynamic model of an economic system must be represented as a differential equation [8].

Research results. Let us consider the functional structure of the interaction of consumer services companies, which consists of two parts: main production (dry cleaning) and additional production (laundry). The dynamics of such an enterprise can be represented by the following scheme:

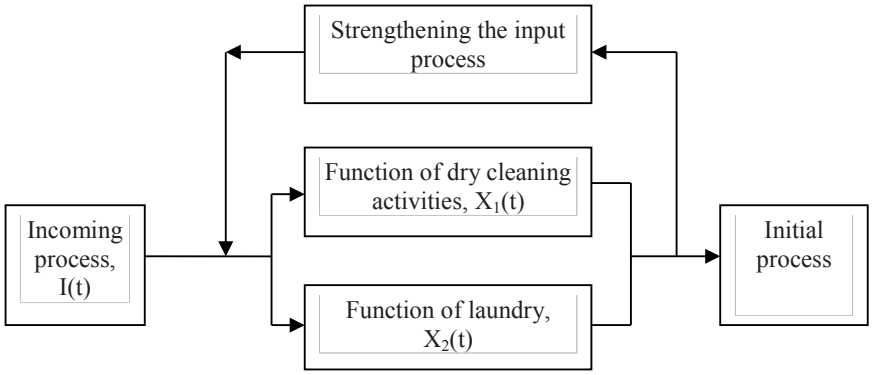

Figure 1 – Functional structure of interaction of the enterprise of consumer services

We will designate the investment function of the enterprise (the centralized system function) by $i(t)$, which transforms into two functions:

$x_1(t)$ – the function of dry cleaning, $x_2(t)$ – the function of laundry. After receiving income, the enterprise, according to the norms, divides it into two parts. One of them goes into production with a zero cycle of the beginning of production activity, which stimulates the investment process and affects the output function of the production system.

If we consider the rate of change of the function of productive assets or its intensity $f'(t)$, depending on the intensity of investment $i(t)$ and capital-intensity depreciation of assets n, it is possible to make the equation:

$$f_k'(t) = a_k x_k(t) + i_k(t) - n_k f_k(t), \quad k = 1,2, \tag{1}$$

where $i_1(t)$–investments, directed to dry-cleaning, $i_2(t)$ – investments, directed to washing; $x_1(t)$, $x_2(t)$ – production functions, of dry-cleaning and washing; a_1, a_2, n_1, n_2 – shares of GDP and the depreciation of each products line.

Let us solve the differential equation of the first order (1) with the help of an operational method [9]. Due to this method, linear differential equations with constant coefficients of the unknown functions $f_k(t)$ can be transformed into algebraic equations with functions $F_k(p)$ as unknown variables.

The image of the original function $f(t)$ is the function $F(p)$ with the complex variable $p = s + iq$, determined by Laplace's integral:

$$F(p) = \int_0^\infty e^{-pt} f(t)\,dt\,.$$

According to basic attributes of the Laplace transform, if $f(t)$ – the base for the image of $F(p)$, then the image of $f'(t)$ will have a base of the function $pF(p)-f(0)$.

Received the following operator equations:

$$pF_k(p)-f_k(0)=a_kX_k(p)+I_k(p)-n_kF_k(p),\quad k=1,2,$$

where $f_1(0), f_2(0)$ – basic conditions of the state of production assets.

Then:

$$F_k(p)=\frac{a_kX_k(p)+I_k(p)+f_k(0)}{p+n_k},\quad k=1,2 \tag{2}$$

Let us suppose that production functions $x_k(t), k=1,2$ depend only on the function of productive assets $f_k(t), k=1,2$ (direct proportional dependence) and does not depend on labor resources and other parameters that have little effect on the final result.

Then in the space of originals we have:

$$x_k(t)=\mu_k f_k(t),\quad k=1,2,$$

where μ_1, μ_2 – capital ratio in accordance with each production. The corresponding operator equations will look like:

$$X_k(p)=\mu_kF_k(p),\quad k=1,2, \tag{3}$$

Substituting the formula (2) in equation (3), we get:

$$X_k(p)=\frac{\mu_kI_k(p)}{p-(a_k\mu_k-n_k)}+\frac{x_k(0)}{p-(a_k\mu_k-n_k)},\quad k=1,2. \tag{4}$$

In practice, quite often there are cases when external investments, which are intended for two productions, depend on the activity of one (main) enterprise [10,11]. Let us suppose that total external investment depends only on the efficiency of the operation of dry cleaning (parameter α). Then:

$$I_1(p)=\alpha X_1(p),\quad 0<\alpha<1. \tag{5}$$

$$I_2(p)=(1-\alpha)X_1(p). \tag{6}$$

Then, substituting (5) into (4) and considering that $i=1$ we get:

$$X_1(p)=\frac{x_1(0)}{p-(a_1\mu_1+\alpha\mu_1-n_1)}$$

or in the original space

$$x_1(t) = x_1(0)e^{(a_1\mu_1+\alpha\mu_1-n_1)t}.$$

Substituting (6) in (4) and considering that $i = 2$ we get:

$$X_2(p) = \frac{\mu_2(1-\alpha)x_1(0)}{a_2\mu_2 - a_1\mu_1 - \alpha\mu_1 - n_2 + n_1}\left(\frac{1}{p-(a_2\mu_2-n_2)} - \frac{1}{p-(a_1\mu_1+\alpha\mu_1-n_1)}\right) + \frac{x_2(0)}{p-(a_2\mu_2-n_2)}.$$

From the last equity we get the first one:

$$x_2(t) = \frac{\mu_2(1-\alpha)}{b_2-b_1}x_1(0)\left(e^{b_2t} - e^{b_1t}\right) + e^{b_2t}x_2(0),$$

where:

$$b_1 = a_1\mu_1 + \alpha\mu_1 - n_1,\ b_2 = a_2\mu_2 - n_2.$$

Let's consider the connection between the production functions at the company of consumer services. It is possible to make a forecast on the dynamics of production for the next period (12 months), having analyzed the data of the service sector enterprise "Monastyrysche-life" for 2015-2017 years, In pic. 2 analyzed different dynamics of enterprises development (dry-cleaning and laundry), depending on the efficiency of the dry cleaning (parameter α). Parameters a_1, a_2, n_1, n_2, μ_1, μ_2, are defined as an average of three years.

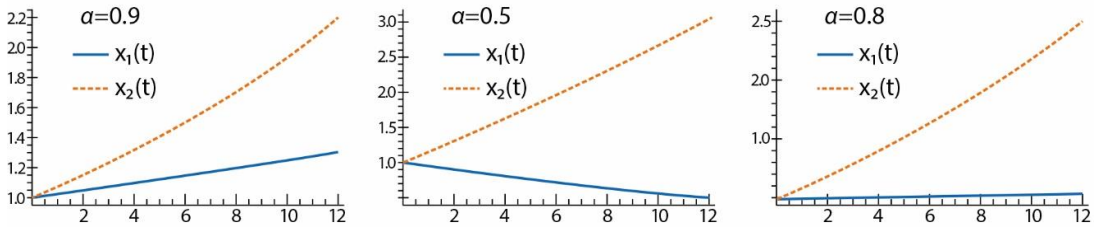

Figure 2 – Dynamics of the functioning of the consumer services company

Source: Calculated by the authors on the basis of the data of LLC "Monastyrysche-life".

Conclusions. The functioning of a small enterprise, which consists of two parts: dry-cleaning and laundry, is considered. Using the apparatus of economic-mathematical modelling of investment activity of the enterprise were analyzed the characteristics that affect the dynamics of the enterprise in general, the self-investment strategy of the enterprise. Illustrated graphs show that it is necessarily to provide a ratio of economic factors, that are responsible for investments.

As a result the operation of the business will not suffer from stagnation or regression, and will work normally according to their own capacities and social needs of the region.

Literature:

[1] New course: reforms in Ukraine 2010-2015: national report / [V. B. Averyanov, B. M. Ajnjuk, B. M. Bogdan, T. P. Borodin and others, for Ed. V.M.Geitsa and others.]; Nat.

acad. Sciences of Ukraine, Section and humanit. sciences - K .: SPC Vernadsky National Library, 2010. - 222 p.
[2] Frederick F. New Zealand's perfect storm of entrepreneurship and economic development / H. Frederick and E Monsen. – Small Business Economics. –2011. –Vol. 37, No 2. –P.187-204
[3] Hasnul G.The effects of government expenditure on economic growth: the case of Malaysiahttps [Electronic resource] / - access mode:
[4] mpra.ub.uni-muenchen.de/71254/
[5] Daniluk T. Existing situation and prospects of development of the Ukrainian market of services / T. Danylyuk // Economic Journal of Lesya Ukrainka Eastern European National University. - 2015. - No. 3. - P. 19-23.
[6] Kundilovskaya T.A. Assessment of the quality of providing consumer services to improve the company / T.A. Kundilovskaya, L.A. Tracchenko // Bulletin of social and economic researches. - 2013. – No. 3. - P.44-50.
[7] Orlats M.K. Methodological Approaches to Socio-Infrastructure Capacity of the Territorial Communities of the Village / M.K. Orlaty // Productivity of agro-industrial production. Economic sciences. - 2015 - No. 27. - 125-132 p.
[8] Khlistunova N.V. Investigation of the state of enterprises of consumer services of Ukraine / N.V. Khlistunova, T.M. Temindarova // Economic analysis. - 2015. - No.19 (2). - P. 164-170.
[9] Kulik A.B. Applying the methods of operating calculus in modeling the process of interaction between small enterprises of the agroindustrial complex: monograph / A.B. Kulik. - K .: KNEU, 2014. -196 p.
[10] Martynenko V.C. Operating calculus. Tutorial / Martynenko V.C. - K .: Vyshashk., 1990. - 359 p.
[11] Sjoholm F. The Role of Small Firms in the Technology Development of China / F. Sjoholm, N. Lundin // The World Economy. Wiley-Blackwell. – 2010. –Vol. 33, No 9. –P.1117–1139.
[12] Guzman-Cuevas J. Functinal dependence and productive dependence of SMEs / J.Guzman-Cuevas, R. Caceres-Carrasco, D. Soriano. – Small Business Economics. – 2009. – Vol. 32, No 3. – P.317-330.