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ROLE OF COMMISSION RECEIPTS IN FORMATION
OF THE REVENUE OF THE COMMERCIAL BANK

Abstract. The expanding of banking services spectrum allows the redistributing of financial risks, the reduce of their negative impact on the efficiency of the commercial bank and creating of new revenue channels. According to this process, the issues of increasing the volume of provision and growth of commission receipts proportion in the general structure of revenues of banking institutions are actualized. In addition, commission receipts more stable than interest, but their not associated with the risk of losing the value of invested assets (except for the guarantee operations). That is why the article is devoted to determination of the effect of impact the volume of commission of banks on the total amount of their income. The research is based on the study of the relationship between the indicators in deal with cubic one-factor regression model. It would be the basic for a diversification of the portfolio of banking services to protect the bank from crises at the financial market and for adoption of effective management decisions. As a result, the significant influence of the growth of commission receipts on the general level of income of commercial banks. This is evidenced by the computed the correlation coefficient (its value is 0.96 and shows the close relationship between the volume of revenues and volumes of their commission receipts), coefficient of determìnacìï, which is 0.91 (that is change the bank`s income on 91.0% depends on the change in the volume of commission receipts of commercial banks) and strong elasticity $E_{CI}(I > 1$ (the increase of commission receipts of banks in Ukraine has a significant impact on the growth of their total). According that it is possible to conclude that the role of commissions in the general process of generating revenues of the bank is increased.

Keywords: banking system, banking operations, commission receipts, system approach, modeling, portfolio of banking services.

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РОЛЬ КОМІСІЙНИХ НАДХОДЖЕНЬ У ФОРМУВАННІ ДОХОДІВ КОМЕРЦІЙНОГО БАНКУ

Анотація. Розширення спектра банківських послуг, що надаються клієнтам, дозволяє перерозподілити фінансові ризики, знижуючи рівень їхнього негативного впливу на ефективність роботи банку, сформувати нові канали надходження доходів. За таких умов актуалізуються питання підвищення обсягів надання і зростання питомої ваги комісійних надходжень у загальній структурі доходів банківських установ. Крім того, комісійні надходження стабільніші, ніж процентні, а їх отримання майже не пов'язане з ризиком втрати вартості вкладених активів (крім гарантійних операцій). Досліджено вплив зміни обсягу комісійних надходжень банків на загальний рівень доходів на основі вивчення зв'язку між зазначеними показниками через використання однофакторної регресійної моделі, що в подальшому надасть можливість диверсифікації портфеля банківських послуг для захисту банків від кризових явищ на фінансовому ринку й ухвалення ефективних управлінських рішень. У результаті виявлено наявність значного впливу зростання обсягу комісійних надходжень на загальний рівень доходів комерційних банків. Про це свідчить розраховані коефіцієнт кореляції (його значення дорівнює 0,96 і показує тісний зв'язок між обсягом доходів банків та обсягами їхніх комісійних надходжень), коефіцієнт детермінації, що становить 0,91 (тобто зміна доходів банків на 91,0 % залежить від зміни обсягів комісійних надходжень комерційних банків) і висока еластичність $E_{CI}(I) > 1$ (приріст комісійних надходжень банків в Україні має значний вплив на зростання загального рівня дохідності). Це дало змогу зробити висновок про підвищення ролі комісійних надходжень у загальному процесі формування доходів банку.

Ключові слова: банківська система, банківські операції, комісійні надходження, системний підхід, моделювання, портфель банківських послуг.

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РОЛЬ КОМИССИОННЫХ ПОСТУПЛЕНИЙ В ФОРМИРОВАНИИ ДОХОДОВ КОММЕРЧЕСКОГО БАНКА

Аннотация. Исследованы вопросы повышения увеличения удельного веса комиссионных поступлений в общей структуре доходов банковских учреждений. Осуществлено моделирование влияния изменения объемов комиссионных поступлений банков на общий размер их доходов на основе исследования связи между указанными

показателями путем использования кубической однофакторной регрессионной модели, что даст возможность диверсификации портфеля банковских услуг для защиты банка от кризисных явлений на финансовом рынке и принятия эффективных управленческих решений. В результате выявлено значительное влияние роста объема комиссионных доходов на общий уровень доходов коммерческих банков и сильную эластичность ($E_{CI}(I) > 1$) между ними, то есть прирост комиссионных доходов банков в Украине имеет значительное влияние на рост общего объема их доходов. Это позволило сделать вывод о повышении роли комиссионных поступлений в общем процессе формирования доходов банков.

Ключевые слова: банковская система, банковские операции, комиссионные поступления, системный подход, моделирование, портфель банковских услуг.

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Introduction. The banking system of Ukraine plays an active role in the processes of building the national economy. However, the current economic situation is not conducive for the development of banking business, despite the fact that domestic banking institutions have taken leadership positions in the financial services market, acting as the largest institutional investors in the state. That is why there is a sharp objective need to find new directions for ensuring the stability of the banking system and decrease the probability of manifestation of systemic risks based on diversification of activities of banking institutions.

Expansion of the spectrum of banking services provided to clients allows redistribution of financial risks, reducing the level of their negative impact on the efficiency of the bank, to form new revenue channels. The above-mentioned actualizes the issue of volumes growth and an increase in the share of commission revenues from the provided banking services in the overall structure of revenues of domestic banks. The practice of distributing such services will positively affect the sustainability of the functioning of individual banking institutions, and, consequently, the banking system of the state as a whole.

Research analysis and problem statement. The scientific literature presents numerous works on the specifics of providing with certain types of banking services by banks, receiving from them commissions and forming revenues on this basis. In particular, it is worth noting the achievements in studying the aforementioned issues in the scientific works of such scholars: Dubyna M. (2016) [2], Zvieriakov M., Kovalenko V., Sheludko S., Sharah O. (2019) [5], Ivanova V. and Kantur S. (2012) [11], Kazarenkova N. and Kolmykova T. (2016) [4], Md. Ariful Islam and Rezvanul Hasan Rana (2017) [7], Prymostka O. and Prymostka L. (2018) [10]. The classical theoretical and methodological basis of these studies are the works of F. Edwards, N. Korrocher, R. Coase, F. Myshkin, B. Reizberg, J. Stigler and others.

However, there is a certain theoretical and methodological vacuum in the direction of studying the role of commission receipts in the income of a commercial bank. Only fragmentarily in scientific works the features of providing with certain types of services (both traditional and non-traditional) by banks and the relationship between the amount of commission income from the provision of such services and revenues of banking institutions are studied.

The purpose of the paper is to investigate the effect of commission receipts from banking services on bank revenues through a one-factor cubic regression model as a basis for making managerial decisions to protect the bank from crises in the market.

Research methods used to achieve the goal are: analysis and synthesis, induction and deduction, forecasting, system-structural method and methods of economic-mathematical modeling to determine the relationship between the size of commission receipts and the total volume of their revenues.

Research results. Commission receipts is the second largest source of income. The amount of the commission fee of the bank is directly related to the volume of services rendered and the fixed tariffs for providing them. It should be noted that in most commercial banks there is an increase in the share of commission income in the total volume of all revenues. This is due to the fact that commission income is more stable than interest one. Receipt of commission income is almost unrelated to the risk of loss of value of invested assets (except guarantee operations) [11, p. 58].

The vast majority of both traditional and non-traditional banking services allow banks to receive, first of all, commission receipts, which leads to a reduction in various types of risks in the

functioning of banking institutions. Reductions in income from classical bank operations are also accompanied by a reduction in commission income from their sale. However, the increase in the provision of other non-traditional services leads to a quick increase in commission receipts in the structure of incomes, and thus provides an increase in their volumes. Usually such inferences are simplified in accordance with the real processes of forming the bank's revenues and their structure. However, in the absence of any cumulative indicators, it is possible to determine the approximate effect of commission revenues on the functioning of the banking system as a whole.

The economic-mathematical modeling is used to identify the coherence between commission receipts of banks and the total volume of their revenues, which allows determining the laws of influence through the deduction of mathematical functions of the relationship between these indicators. It is economic and mathematical methods that can reveal what is important; describe with the help of dependency functions the interaction between different economic processes. Mathematical dependencies will allow to establish the levels of dependence, influence, interaction between the commission receipts of banks and the total volume of their incomes with a rather high probability and substantiate the necessity to increase the volumes of non-traditional banking services, the proceeds from which are the commission receipts.

For this purpose, aspects of correlation-regression analysis are used, the feature of which is the construction of a regression model, within which the link between one variable y (total amount of incomes of banking institutions), which is dependent, and the independent variable x (volume of commission revenues of Ukrainian banks) is considered [1, p. 69—70]. To determine the effect of the size of commission receipts on the volume of income of banking institutions from all models of correlation-regression analysis, the optimal option is to construct a one-factor cubic regression model.

However, constructing a clear model that would describe all patterns of dependence between these parameters is rather difficult and practically impossible. That is why, in order to form functional relationships between the two variables in the research process, it is expedient to use an intermediate model - an empirical equation or an estimation dependence. Such parameters of the econometric model are determined by the authors using the least squares method (LSM), which is already a classic way of selecting the most optimal dependence function. In most cases, this approach is used to find linear model parameters; however, in cases of constructing parabolic and hyperbolic functions, it is also useful and convenient. Accordingly, the LSM is that the very smallest value of the error gives grounds to assert about obtaining the best model from the existing large set of them. However, in reality, with one value, of course, it is impossible to construct a regression possibility. To do this, they use a set of indicators: the amount of deviations of the value from the value of the trend, which describes the tentative dependence. The amount of deviations can take both positive and negative values. In order to determine the total amount of deviations, a model of each time when determining the deviation for each value, is considered.

Therefore, in order to find such estimating parameters of the model, it is necessary to determine the equation of dependence in which the amount of deviations would be the lowest. A prerequisite for performing a function minimum is the zero of the derivatives of this function by its parameters. For a cubic one-factor model, when looking for derivatives, we obtain the following equation system:

$$\begin{cases} a_3 \sum x_i^3 + a_2 \sum x_i^2 + a_1 \sum x_i + na_0 = \sum y_i; \\ a_3 \sum x_i^4 + a_2 \sum x_i^3 + a_1 \sum x_i^2 + a_0 \sum x_i = \sum x_i y_i; \\ a_3 \sum x_i^5 + a_2 \sum x_i^4 + a_1 \sum x_i^3 + a_0 \sum x_i^2 = \sum x_i^2 y_i; \\ a_3 \sum x_i^6 + a_2 \sum x_i^5 + a_1 \sum x_i^{34} + a_0 \sum x_i^3 = \sum x_i^3 y_i. \end{cases} \quad (1)$$

To construct a one-factor cubic regression model, the relationship between the level of commission receipts of banking institutions with the total volume of their income, will be used official statistics of the National Bank of Ukraine [8]. Using them, we build a relationship between the above indicators, which in the end should lead to the determination of the equation of dependence between these two parameters. It is necessary to make intermediate calculations, which are presented in *Table 1*, aimed to determine the system of normal equations using *formula 1*.

Table 1

Intermediate calculations to find the equation for the relationship
between income level of banks and the amount of commission, received by them

i	2010	2011	2012	2013	2014	2015	2016	2017	2018	Σ
x_i	16.21	15.27	18.47	21.16	24.97	28.28	28.41	31.36	37.12	221.25
y_i	143	136.85	142.78	150.45	168.89	210.2	199.19	190.69	178.24	1520.29
x_i^2	262.76	233.17	341.14	447.75	623.5	799.76	807.13	983.45	1377.89	5876.55
x_i^3	4259.41	3560.55	6300.87	9474.3	15568.82	22617.17	22930.51	30840.98	51147.44	166700.04
x_i^4	69044.97	54369.6	116377.11	200476.12	388753.37	639613.5	651455.77	967173.12	1898592.98	4985856.54
x_i^5	1119219	830223.81	2149485.29	4242074.75	9707171.71	18088269.73	18507858.42	30330548.91	70475771.33	155450622.95
x_i^6	18142539.99	12677517.61	39700993.29	89762301.67	242388077.51	511536268.08	525808257.72	951166013.81	2616060631.65	5007242601.3
$x_i\,y_i$	2318.03	2089.7	2637.15	3183.52	4217.18	5944.46	5658.99	5980.04	6616.27	38645.33
$x_i^2\,y_i$	37575.27	31909.71	48708.1	67363.33	105303.07	168109.22	160771.85	187534	245595.9	1052870.43
$x_i^3\,y_i$	609095.07	487261.29	899638.56	1425407.97	2629417.58	4754128.62	4567528.15	5881066.37	9116519.73	30370063.35

Source: compiled based on the calculations, conducted with the help [6].

We will obtain the following equation system, taking into account data from *Table 1*:

$$\begin{cases} 166700{,}04a_3 + 5876{,}55a_2 + 21{,}25a_1 + 9a_0 = 1520{,}29; \\ 4985856{,}54a_3 + 166700{,}04a_2 + 5876{,}55a_1 + 221{,}25a_0 = 38645{,}33; \\ 155450622{,}95a_3 + 4985856{,}54a_2 + 166700{,}04a_1 + 5876{,}55a_0 = 1052870{,}43; \\ 5007242601{,}32a_3 + 155450622{,}95a_2 + 4985856{,}54a_1 + 166700{,}04a_0 = 30370063{,}35. \end{cases}$$

If we solve this system of linear equations using the Cramer method, we obtain a regressive dependence between the volumes of Ukrainian banks' income and the level of commission they received:

$$\hat{y} = -0{,}03x^3 + 2{,}5x^2 - 53{,}92x + 503{,}89.$$

Let's introduce certain notations:
$y = I$ — the level of income of banks, the value of the dependent variable;
$x = CI$ — the amount of commission receipts, independent variable value.
Thus:

$$I = -0{,}03CI^3 + 2{,}5CI^2 - 53{,}92CI + 503{,}89.$$

This dependence can be illustrated graphically, its appearance is presented in *Fig. 1*.
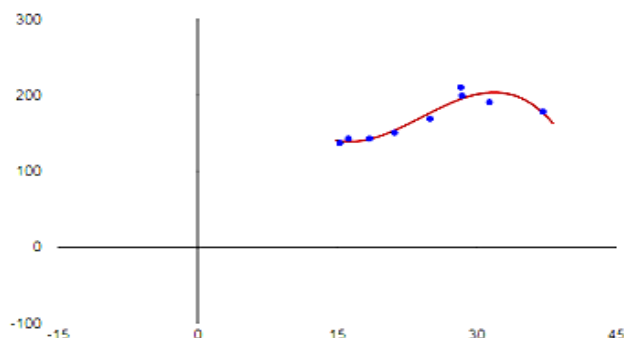

Fig. 1. The regression model of the dependence between the cumulative indicator of the volume of income and the amount of commission received by all banks in Ukraine

Source: compiled by the authors.

The next step in determining the income dependence equation from the size of commission receipts of the bank is to analyze the model and check it for adequacy. To do this, they conduct correlation analysis and determine the correlation coefficients (R) and the determination. In addition, to test the model using Fisher's F-criterion, which allows you to determine the significance of the connection itself, is used.

Thus, we will determine the indicators of correlation coefficient, determination and Fisher's F-criterion for our model in order to confirm its correctness and correspondence to the real existing connection between the level of income of banks and their commissions. Of course, such dependence at first glance can be traced if we analyze statistical data; however, econometric modeling also allows determining mathematically such a dependence, which makes it possible to make certain forecasts of further changes in the structure of income formation of banks in Ukraine.

We will conduct additional calculations in order to find these indicators (*Table 2*).

Thus, we obtain that the correlation coefficient ≈ 0.96. Consequently, the relationship between the volume of bank revenues and the volume of their commission receipts is tight, since the correlation coefficient is in the range of 0.96. The criteria for this indicator are values in the range from 0 to 1.

Table 2

Additional data for determining the correlation, determination and *F*-criterion indicator coefficients

I	x_i	y_i	$\hat{y}_i$	$y_i = \bar{y}$	$(y_i = \bar{y})^2$	ε_i	ε_i^2	A_i	$\Delta\varepsilon_i$	$(\Delta\varepsilon_i)^2$
2010	16.21	143	138.69	−25.92	671.9	4.31	18.56	0.03	—	—
2011	15.27	136.85	139.64	−32.07	1028.56	−2.79	7.76	0.02	−7.09	50.31
2012	18.47	142.78	142.01	−26.14	683.36	0.77	0.59	0.01	3.55	12.63
2013	21.16	150.45	153.54	−18.47	341.18	−3.09	9.55	0.02	−3.86	14.89
2014	24.97	168.89	176.48	−0.03	0	−7.59	57.56	0.04	−4.5	20.23
2015	28.28	210.2	194.72	41.28	1703.95	15.48	239.76	0.07	23.07	532.29
2016	28.41	199.19	195.29	30.27	916.21	3.9	15.22	0.02	−11.58	134.15
2017	31.36	190.69	203.35	21.77	473.88	−12.66	160.27	0.07	−16.56	274.29
2018	37.12	178.24	176.58	9.32	86.84	1.66	2.75	0.01	14.32	205.05
$\Sigma\Sigma$	—	—	—	—	5905.88	—	512.03	0.29	—	1243.84

Source: compiled by the authors on the basis [6].

The closer the value to 1, the closer the connection. The value of the determination coefficient will be:

$$R^2 = 0{,}96^2 \approx 0{,}91.$$

This means that the change in banks' revenues by 91.0% depends on changes in the volumes of commissions earned by commercial banks.

In order to justify the significance of the connection, the value of the *F*-criterion obtained by Fischer is compared with its tabular value with a certain probability error. If $F_{fact.} > F_{tabl.}$, then it can be argued that the constructed regression model is significant and corresponds to real reality, that is, the model describes that relationship that exists.

$$F_{fakt} = \frac{R^2}{1-R^2} * \frac{k_2}{k_1} = \frac{0{,}91}{1-0{,}91} * \frac{5}{3} \approx 17{,}56.$$

Since $k_1 = m = 3$, $k_2 = n - m - 1 = 9 - 3 - 1 = 5$, by $\alpha = 0{,}05$; where m — is the number of parameters for variables of the regression equation.

$$F_{tabl} \approx 5,4095 \text{ where } \alpha = 0,05.$$

Since $F_{fact.} > F_{tabl,}$ then it can be argued that the constructed regression model is significant and corresponds to real reality.

Thus, estimated values of the correlation coefficients, the determination and the Fisher's *F*-criterion confirm the correctness of constructing the model of the influence of commission on the volume of bank revenues.

The obtained results showed a close correlation between the analyzed indicators. This testifies to the important role of non-traditional banking services in the formation of commission receipts of banks and the volume of income throughout the banking system. Taking into consideration the outcomes obtained, we determine the coefficient of elasticity between the indicated parameters. Calculation of this coefficient allows obtaining information on how the dependent parameter changes when the independent variable changes. In the framework of this study, we will determine the usual (relative) elasticity.

For models that do not have a linear relationship, the elasticity formula is different. This is due to the presence of different results in the process of differentiation of the dependence equations used to derive the formulas of this coefficient. Given the conditions of our model, the coefficient of elasticity will be determined as follows:

$$Ex(y) = \left| \frac{\partial y}{\partial x} * \frac{x}{y} \right| = \left| \frac{(a_1 + 2a_2 CI + 3a_3 CI^2) * CI}{a_0 + a_1 CI + a_2 CI^2 + a_3 CI^3} \right| = \left| \frac{a_1 CI + 2a_2 CI^2 + 3a_3 CI^3}{a_0 + a_1 CI + a_2 CI^2 + a_3 CI^3} \right| \quad (2)$$

Thus, $E_{CI}(I) = \left| \frac{a_1 CI + 2a_2 CI^2 + 3a_3 CI^3}{a_0 + a_1 CI + a_2 CI^2 + a_3 CI^3} \right| = \left| \frac{-53,92 CI + 5 CI^2 - 0,09 CI^3}{503,88 - 53,92 CI + 2,5 CI^2 - 0,03 CI^3} \right|.$

We can calculate the elasticity coefficients for each period for which we gained an information, using official statistics of the National Bank of Ukraine [8]. *Fig. 2* illustrates the results of such calculations.
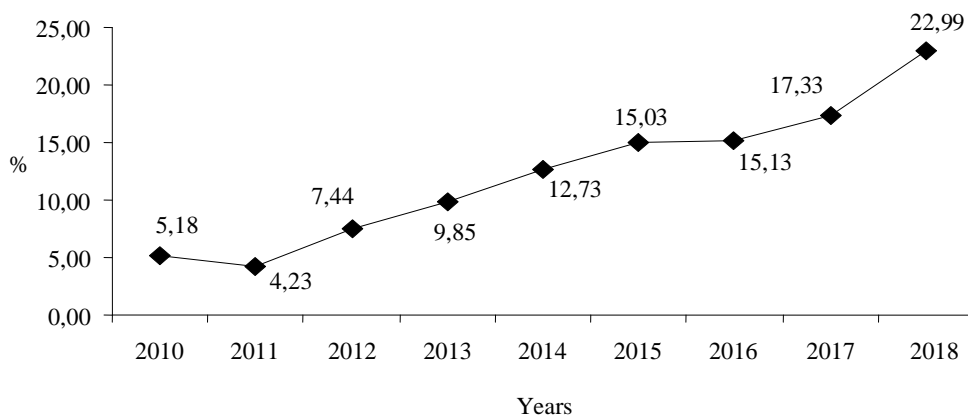
Fig. 2. Results of determining the elasticity of changes in income of commercial banks from changing level of their commission receipts
Source: compiled by the authors.

Consequently, it can be argued about the normal elasticity between the change in the volume of income of commercial banks and the change in their commission income. Moreover, the degree of quantitative change in the volume of income of commercial banks from changes in their commission receipts increases each year.

The indicators obtained of calculation of the coefficient of elasticity should be defined in accordance with the following criteria (*Fig. 3*):

Calculation of the elasticity of the dependence of income level on the volume of commission receipts of commercial banks

$$Ex(y) = \left| \left[\frac{\Delta y}{y} \right] / \left[\frac{\Delta x}{x} \right] \right| = \left| \frac{\Delta y}{y} * \frac{x}{\Delta x} \right| = \left| \frac{\Delta y}{\Delta x} * \frac{x}{y} \right| = \left| \frac{\partial y}{\partial x} * \frac{x}{y} \right|$$

$Ex(y)$ – coefficient of elasticity; Δy – change function $y=f(x)$; Δx – change the argument x;
y – the point of the dependent variable; x – the point of the independent variable.

One-factor cubic regression model of dependence of income on the volume of commission receipts of banks
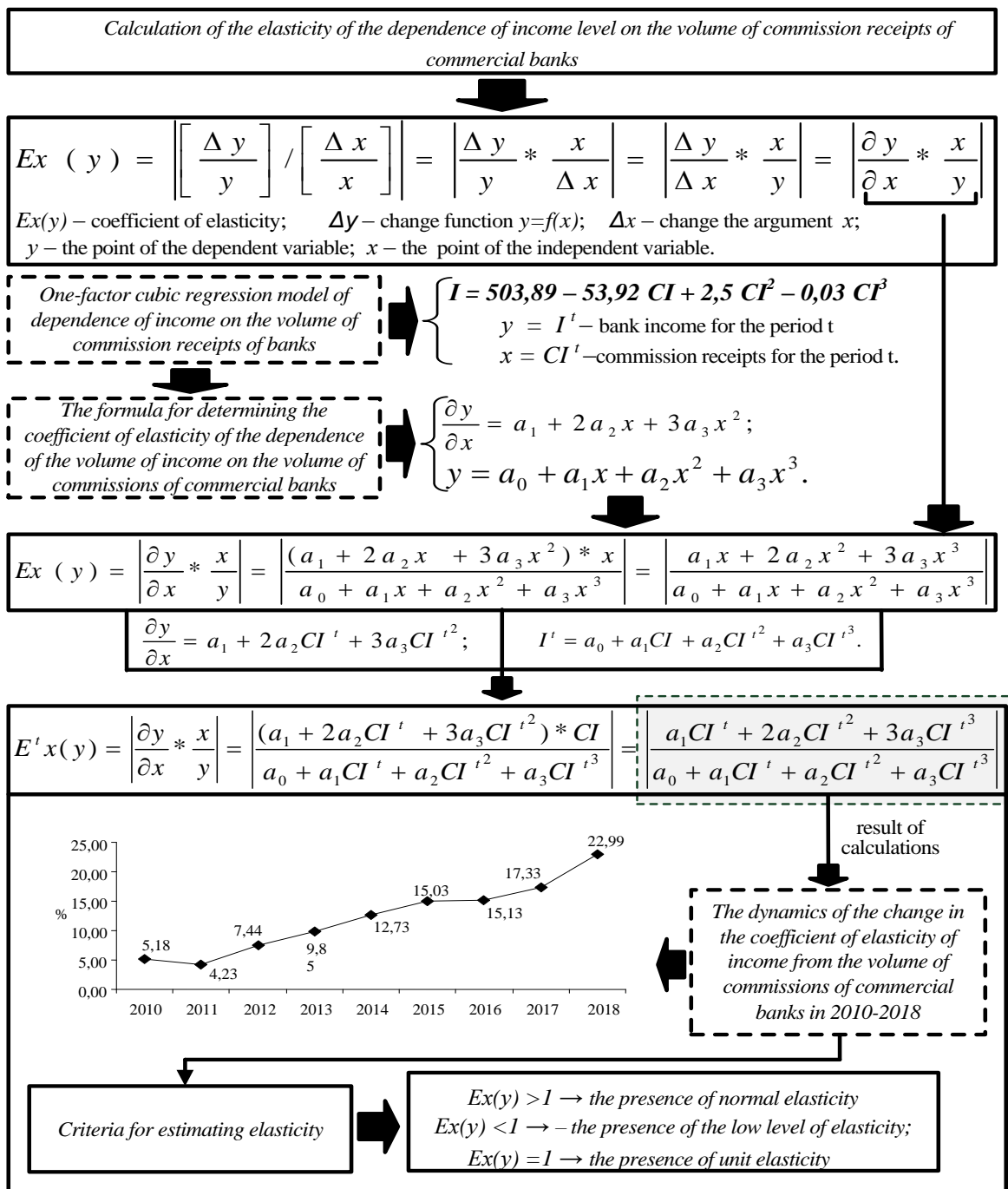
$$\begin{cases} I = 503{,}89 - 53{,}92\,CI + 2{,}5\,CI^2 - 0{,}03\,CI^3 \\ y = I^t - \text{bank income for the period t} \\ x = CI^t - \text{commission receipts for the period t.} \end{cases}$$

The formula for determining the coefficient of elasticity of the dependence of the volume of income on the volume of commissions of commercial banks

$$\begin{cases} \dfrac{\partial y}{\partial x} = a_1 + 2a_2 x + 3a_3 x^2; \\ y = a_0 + a_1 x + a_2 x^2 + a_3 x^3. \end{cases}$$

$$Ex(y) = \left| \frac{\partial y}{\partial x} * \frac{x}{y} \right| = \left| \frac{(a_1 + 2a_2 x + 3a_3 x^2)*x}{a_0 + a_1 x + a_2 x^2 + a_3 x^3} \right| = \left| \frac{a_1 x + 2a_2 x^2 + 3a_3 x^3}{a_0 + a_1 x + a_2 x^2 + a_3 x^3} \right|$$

$$\frac{\partial y}{\partial x} = a_1 + 2a_2 CI^t + 3a_3 CI^{t2}; \qquad I^t = a_0 + a_1 CI + a_2 CI^{t2} + a_3 CI^{t3}.$$

$$E^t x(y) = \left| \frac{\partial y}{\partial x} * \frac{x}{y} \right| = \left| \frac{(a_1 + 2a_2 CI^t + 3a_3 CI^{t2})*CI}{a_0 + a_1 CI^t + a_2 CI^{t2} + a_3 CI^{t3}} \right| = \left| \frac{a_1 CI^t + 2a_2 CI^{t2} + 3a_3 CI^{t3}}{a_0 + a_1 CI^t + a_2 CI^{t2} + a_3 CI^{t3}} \right|$$

result of calculations

The dynamics of the change in the coefficient of elasticity of income from the volume of commissions of commercial banks in 2010-2018

Chart values (%): 2010 — 5,18; 2011 — 4,23; 2012 — 7,44; 2013 — 9,8 / 5; 2014 — 12,73; 2015 — 15,03; 2016 — 15,13; 2017 — 17,33; 2018 — 22,99

Criteria for estimating elasticity

$Ex(y) > 1 \rightarrow$ the presence of normal elasticity
$Ex(y) < 1 \rightarrow$ – the presence of the low level of elasticity;
$Ex(y) = 1 \rightarrow$ the presence of unit elasticity

Fig. 3. A generalized model for determining elasticity between commission receipts of banks and their total revenues
Source: compiled by the author.

Conclusions. As a result of the study, it was confirmed that there was a significant effect of the increase in commission receipts on the total income of commercial banks. A model for determining the elasticity between commission income and income level is developed, and the elasticity coefficient, which tends to increase, is defined. (2012 — 7,44; 2013 — 9,85; 2014 — 12,73; 2015 — 15,03; 2016 — 15,13; 2017 — 17,33; 2018 — 22,99), which made it possible to conclude on the steady increase in the role of commission receipts in the overall process of generating revenues of the bank, since, in addition to traditional commission services, all groups of payments provided by banks through online platforms and with the help of modern information technologies are included in the defined group.

The outcomes of the survey show that each year the influence of commission income on the cumulative income indicator in the banking system increases ($E_{CI}(I) > 1$). This makes it possible to determine commission receipts as one of the dominant factors in the formation of the level of profitability of a commercial bank and should further serve as a basis for effective management decisions in applying

the best practices of financial management, development of strategic directions for the construction of a stable functioning banking system, raising the level of innovative activity of commercial banks and improving the system for providing diversified financial services to clients of banking institutions.

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