

4. МОДЕЛЮВАННЯ ТА АНАЛІЗ ДАНИХ В ЕКОНОМІЦІ

Poznyak S. P.,

PhD candidate,

Kolyada Yu. V.,

Doctor of Economic Sciences, Associate Professor,

Kyiv National Economic University named after Vadym Hetman

MARKET TYPOLOGY IN ECONOMIC GROWTH DYNAMICS MODELING

Introduction. Economic growth reflects national welfare, productivity, and global competitiveness. Modern approaches to modeling economic growth go beyond classical and neoclassical models, using multidimensional structures that include human capital, innovation, and institutions, but most models assume perfect competition. Real markets often differ – monopolies, oligopolies, and monopolistic competition shape investment, efficiency, and innovation differently. Ignoring these structures can distort conclusions about growth and policy impact. Market typology affects resource allocation, pricing, and firm behavior, influencing long-term development. Integrating market diversity into growth models enhances accuracy, explains policy roles better, and supports tailored tools for analyzing complex economic dynamics.

Methodology. We used an endogenous economic growth model that takes into account the advantages and disadvantages of models [1], includes foreign trade and investment, and is described in detail in [2-3].

In the model, the main factors of production are private capital K_{pr} , public capital K_{gov} , human capital (knowledge) H , labor L and the variable factor R . Variable factor R in a single-sector production model is responsible for the land factor N . A modified Cobb-Douglas function of the form:

$$Y_p = AK_{pr}^{\alpha} K_{gov}^{\beta} H^{\gamma} N^{\varphi} L^{1-\alpha-\beta-\gamma-\varphi}, (1)$$

where α – is the coefficient of elasticity of private capital, β – public capital elasticity coefficient, γ – human capital elasticity coefficient, φ – elasticity of the variable factor, in this case, land [2-3]. The model separates capital into private and public components to better capture their distinct roles in economic growth. Investments are driven by aggregate savings, reflecting the economy's capacity to allocate resources effectively. Capital dynamics are described by private capital intensity (private investment), public capital intensity (infrastructure and public goods), and savings per unit of labor (the main investment source). This framework enables a deeper analysis of how private and public investments interact and influence labor productivity and long-term growth [2-3]. The innovation sector generates new knowledge by the production function:

$$\Delta H = BK_{rd}^{\nu} L_{rd}^{1-\nu}, \quad (2)$$

where K_{rd} – capital raised in the innovation sector, L_{rd} – labor involved in the innovation sector, ν – capital elasticity in the innovation sector.

Full multivariate model in general form [2-3]:

$$\begin{cases} k_{pr}^{\bullet} = i_{in} + i_f - (d_{pr} + n)k_{pr}, \\ k_{gov}^{\bullet} = g - (d_{gov} + n)k_{gov} + tx, \\ m^{\bullet} = sAk_{pr}^{\alpha} k_{gov}^{\beta} h^{\gamma} n_N^{\varphi} - (g + nm + i_{in} + i_{out}), \\ h^{\bullet} = Bk_{rd}^{\nu} l - nh, \end{cases} \quad (3)$$

where k_{pr} – capital intensity of the private sector, d_{pr} – amortization rate of private capital, n – average growth rate of the employed labor force, i_{in} – domestic investment per unit of labor, i_f – foreign investment per unit of labor, k_{gov} – capital intensity of the public sector, g – taxes per unit of labor, d_{gov} – depreciation ratio for public capital, tx – net government international transfers, m – total savings per unit of labor, s – savings rate, n_N – land factor per unit of labor, i_{out} – external investment per unit of labor.

After examining general aspects of economic growth and its modeling, it is crucial to focus on a key element – market structure – which heavily influences firm behavior, resource efficiency, innovation, investment, and the scope of government regulation. Based on these criteria, market types include perfect competition,

monopolistic competition, oligopoly and monopoly. As most classical growth models assume perfect competition, this type will be considered first.

Perfect competition describes a market where many small firms sell identical products without influencing prices. Key features include free market entry and exit, full information, and no barriers. While rare in reality, markets like agriculture, commodities, and currencies come close, as global supply and demand drive prices. This structure ensures high efficiency—firms minimize costs, prices reflect marginal costs, and resources are used optimally, benefiting consumers and maximizing social welfare. However, it has downsides: limited profits restrict investment in costly innovation, scale inefficiencies persist, and externalities like pollution remain unaddressed without government regulation. To model a market of perfect competition, we will use model (3) in its entirety, since it meets all the features of the relevant market type.

A pure monopoly occurs when one supplier controls the entire market, with no close substitutes and full pricing power. Examples include utilities like water or electricity, where one provider is most efficient. Unlike perfect competition, monopolies set higher prices and face little competition due to high entry barriers. They benefit from stable profits, economies of scale, and long-term planning. However, they may also raise prices, reduce quality, and stifle innovation, harming consumers. Government regulation is often needed to protect public interest. Though monopolies can invest more, they often underinvest due to the high cost of maintaining dominance. To account for these costs, we introduce a coefficient θ equal to:

$$\theta = \frac{Y_m}{Y_p}, \quad (4)$$

where Y_m – output at a monopoly, Y_p – a similar output with perfect competition, and $0 < \theta < 1$, since output is always lower under a monopoly. Then the growth model for a monopoly will take the form:

$$\begin{cases} k_{pr}^{\bullet} = i_{in} + i_f - (d_{pr} + n)k_{pr}, \\ k_{gov}^{\bullet} = g - (d_{gov} + n)k_{gov} + tx, \\ m^{\bullet} = s\theta A k_{pr}^{\alpha} k_{gov}^{\beta} h^{\gamma} n_N^{\varphi} - (g + nm + i_{in} + i_{out}), \\ h^{\bullet} = B k_{rd}^{\nu} l - nh. \end{cases} \quad (5)$$

According to expression (5), the costs of securing monopoly power will reduce overall savings, which in turn will more severely limit investment opportunities and lead to lower economic growth.

An oligopoly is a market structure where a few large firms dominate, making decisions that depend on their rivals' actions. It features high concentration, entry barriers, and potential for collusion. Common in aviation, telecoms, and car industries, oligopolies can influence prices but still face competition. They offer economies of scale, strong R&D, and global growth, driving innovation and progress. However, risks include collusion, limited competition, fewer consumer choices, and slower innovation if firms focus more on control than advancement.

An oligopoly is an intermediate position between perfect competition and monopoly. It combines high profits, as in a monopoly, with a certain level of competition, which forces companies to innovate. In an oligopoly, there are also costs of securing market power, but they are smaller than in a pure monopoly. In the model, this can be defined as:

$$\begin{cases} k_{pr}^{\bullet} = i_{in} + i_f - (d_{pr} + n)k_{pr}, \\ k_{gov}^{\bullet} = g - (d_{gov} + n)k_{gov} + tx, \\ m^{\bullet} = s\theta^{\frac{1}{N}}Ak_{pr}^{\alpha}k_{gov}^{\beta}h^{\gamma}n_N^{\varphi} - (g + nm + i_{in} + i_{out}), \\ h^{\bullet} = Bk_{rd}^{\nu}l - nh, \end{cases} \quad (6)$$

where N – number of oligopolists. Thus, in a monopoly, the expression $\theta^{\frac{1}{N}} = \theta^{\frac{1}{1}} = \theta$, and with perfect competition $\theta^{\frac{1}{N}} = \theta^{\frac{1}{\infty}} \approx \theta^0 = 1$, which is fully consistent with the limitations of market types.

Monopolistic competition combines elements of monopoly and perfect competition, with many firms offering similar but differentiated products. Low entry barriers lead to frequent market changes, as seen in restaurants, fashion, and cosmetics. Firms can charge slightly higher prices due to branding but still face strong competition. This promotes innovation, variety, and responsiveness to consumer needs. However, it can cause inefficiencies from high marketing costs, consumer confusion from too much choice, and unstable profits due to constant competition and changing demand. In monopolistic competition, a new type of cost emerges – product differentiation costs, which are taken into account in the model using the coefficient q :

$$\left\{ \begin{array}{l} k_{pr}^{\bullet} = i_{in} + i_f - (d_{pr} + n)k_{pr}, \\ k_{gov}^{\bullet} = g - (d_{gov} + n)k_{gov} + tx, \\ m^{\bullet} = sq\theta^{\frac{1}{N}}Ak_{pr}^{\alpha}k_{gov}^{\beta}h^{\gamma}n_N^{\varphi} - (g + nm + i_{in} + i_{out}), \\ h^{\bullet} = Bk_{rd}^{\nu}l - nh. \end{array} \right. \quad (7)$$

In monopolistic competition, product differentiation costs are extra expenses firms incur to make their goods or services stand out. These include spending on marketing, branding, design, packaging, innovation, and quality improvements—costs that don't directly increase output or consumption. We will estimate these costs using the formula:

$$q = \frac{Y - C_d}{Y}, \quad (7)$$

where C_d – costs of differentiation, a Y – output volume. In the case of a monopoly, oligopoly or pure competition, these costs will approach 0, and the coefficient, in turn, will approach 1, so it will not affect.

Conclusions. The article thoroughly analyzes the impact of market structure on economic growth by modifying the author's multidimensional model, which includes additional coefficients for different types of markets. For monopolistic competition, the coefficient of product differentiation costs is taken into account, for monopoly - the coefficient of volume decline adjusted for the number of market participants, which is also typical for oligopoly. The model for perfect competition remained unchanged, which made it possible to compare the accuracy of forecasts for different market conditions.

References

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