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The Study of Specific Empirical Patterns of the Influence of State Macrofinancial Policy on Stimulating Innovation Activity Within the Framework of Endogenous Growth Theory

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ABSTRACT

The **subject** of the study is the empirical patterns of the influence of the state macrofinancial policy on stimulating innovation activity within the framework of the endogenous theory of growth. The **purpose** of the paper is to propose an approach aimed at ensuring direct market competition between several firms in each industry, which combines the concept of endogenous growth with a dynamic industry model of ideal Kurnout — Nash equilibrium. The scientific contribution and **novelty** of the research lies in the development of new and improvement of key methodological approaches already used to assess the impact of R&D subsidies on endogenous productivity growth. In particular, new key characteristics of competition through R&D are introduced, which are usually absent in most endogenous growth models, including: 1) deterministic entry and exit from the market; 2) the distribution of firm sizes; and 3) more complex market structures that vary by industry and over time. The main **conclusion** is the fact that the results obtained by the author confirm the correctness of using the proposed methodological approach. The summary results confirm the existence of partial equilibrium conditions for a particular industry, demonstrating how growth-stimulating subsidies for R&D change the endogenously determined structure of the market. R&D subsidies "stretch" the distribution of market shares by increasing the number of firms in the market, but at the same time increase the differences in market shares between firms. The new methodological approach proposed by the author provides an important step towards the study of a more formalized apparatus for studying the dynamic industry model of ideal equilibrium.

Keywords: empirical patterns; macrofinancial policy; theory of endogenous growth; innovations; R&D

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INTRODUCTION

What is the relationship between market structure and economic growth? This broad yet fundamental macroeconomic question has been addressed in many studies dedicated to endogenous growth [1–3]. However, the authors of these studies attempted to base their work on strict assumptions regarding market structure in order to maintain analytical modelability. These assumptions include two main types: 1) either a single monopolist dominates all industries, exiting the game only through "creative destruction"; 2) or firms compete in some form of monopolistic competition, where each firm still holds a monopoly but competes with all other firms in the economy as an infinitely small player. In particular, firms in these models do not compete directly in the same product markets, and therefore, the consequences of competition are explained by theoretical market structures that possess only a few characteristics that one would typically expect when describing a market with imperfect competition. In this paper, the author proposes to expand the scope of existing research on endogenous growth by incorporating models within the framework of the endogenous growth concept with a dynamic industry model of perfect equilibrium, which will allow for the modeling of direct competition in the goods market, assuming Cournot competition, as opposed to the standard assumption of Bertrand competition. This assumption allows heterogeneous firms to compete in the same market and maintain a stable market share. Firm-level heterogeneity creates dynamic competitive pressure on firms, forcing them to actively invest in R&D. In the author's hypothetical model, firms implement technological innovations that lead to a reduction in production costs. As a result, economic growth is driven by the incentives that arise for firms to lower production costs. At the same time, these incentives are influenced by the market structure, which is determined by both the number of firms and the distribution of production costs among firms. Two more key assumptions should be noted.

Firstly, innovations initially have a temporary private character and then gradually spread throughout the economy, becoming available to other market participants. In most endogenous growth models, innovations immediately spread to the rest of the economy, but competing firms do not enter the market due to the Bertrand competition assumption. However, the slow diffusion of technological processes encourages firms to acquire and enhance technological advantages while simultaneously preventing the permanent monopolization of industries, as would be the case with zero knowledge diffusion.

Secondly, new firms enter the market with below–average productivity. This assumption is made to ensure that the exit hazard rate is negatively related to the age of the firm, which is a significant empirical observation found in individual studies. It sharply contrasts with studies dedicated to endogenous growth, according to which the exit hazard rate is constant and does not depend on the age of the firm.

The method used by the author for solving is based on the Markov perfect dynamic industry model by R. Ericson and A. Pakes [4], as well as A. Pakes and P. McGuire [5]. In the author's model, in each production period, its prices and volumes are determined according to the Cournot–Nash equilibrium, while firms maximize their current discounted value by choosing the level of R&D expenditures in addition to decisions about entering and exiting the market. The dynamic equilibrium is the perfect Markov — Nash equilibrium with an ergodic distribution over the market structure. Thus, the method used by the author involves the distribution of market structures, implying that the industry develops and changes over time, simulating a turbulent, evolving industry environment.

The advantage of this approach is that it allows for the explicit calculation of the ergodic distribution in a steady state and its comparison with the steady states arising under certain macroeconomic conditions. Moreover, the model enables us to consider more important moments of the distribution of firms by size (variance, skewness, etc.) and how they respond to certain changes in macrofinancial policy. This paper presents a partial equilibrium model that allows for a focus on the joint determination of economic growth mechanisms and market structure. At the same time, potentially important feedback effects are not considered. Nevertheless, the results presented here are interesting in their own right. Firstly, the paper demonstrates that this class of models can explain a sufficient number of "standard examples" encountered in empirical studies of industry market dynamics. Secondly, the empirical analysis presented in the paper shows that R&D taxes hinder companies' involvement in R&D and lead to a more competitive market structure, while subsidies have the opposite effect. This result sharply contrasts with the analysis within the framework of creative destruction models, where taxes are used to reduce the rate of monopoly replacement, while subsidies stimulate firms.

Based on the objectives and tasks of the research, the paper has the following logical structure. First of all, we need to conduct a deep theoretical and methodological analysis of the existing studies on endogenous economic growth, as well as in the field of macroeconomic aspects of assessing the impact of subsidies on R&D on endogenous productivity growth. Next, we will present a theoretical description of the modeling approach used in our research. Then we will proceed to discuss the empirical results of our model's behavior based on the analysis of the partial equilibrium model for a specific industry and discuss the impact of taxes and subsidies on R&D. In conclusion, we will summarize our findings and outline the prospects for further research.

SEPARATE KEY EMPIRICAL REGULARITIES OF THE ENDOGENOUS GROWTH CONCEPT WITHIN THE FRAMEWORK OF A DYNAMIC INDUSTRY MODEL

Before proceeding to a detailed review and critical analysis of the main theoretical and methodological approaches, it will be useful to briefly familiarize ourselves with some key empirical regularities or "standard examples" encountered in empirical studies on the dynamics of industry markets. The purpose of such an introduction follows from one of the main hypotheses of this paper, which is that the proposed market structure matters, and therefore, a model that reflects at least some of the key empirical regularities would be more useful for understanding how macrofinancial policy can influence long-term economic growth and welfare through feedback due to changes in the equilibrium market structure.

There are numerous empirical studies in this field; however, the author will rely only on select works that directly link these "standard examples" with empirical research on endogenous growth. The most noteworthy are the studies by J. Klett and S. Kortum [6], J. Klett and Z. Griliches [7], W. Cohen and R. Levin [8], R. Shmalenzi [9]. Below is an incomplete list of many "standard examples" that are recognized in the scientific community; the others (not listed here) are quite controversial in scientific circles. The purpose of presenting them here is to demonstrate the strengths (and weaknesses) of the subsequent model, which exhibits these features that are not properties of many endogenous growth models.

1. The essence of the first "standard example" is that large firms are inclined towards innovation and invest more in R&D. In individual studies [10–13], the authors note that "quality ladder" models suggest that new innovations are implemented exclusively by new firms, which contradicts the fact that dominant firms are more inclined to adopt innovations. Authors of other studies [14–16] argue that firms with a larger market share are more likely to implement innovations, but the increase in market concentration due to innovations by large firms reduces the overall level of innovations. However, authors of the third line of research [17–19] provide evidence that small firms in certain industries contribute a larger share of "significant innovations", while overall, large firms account for a larger share across all industries.

A bit ahead of ourselves, based on calculated data in OECD countries,* in *Figure 1* we will show the ratio of R&D investments of the largest firm in the market at a given point in time and four small firms depending on their market presence. The diagram clearly shows that large firms spend more on R&D than small ones. Since they all use the same R&D technologies, it follows that larger firms will implement more innovations. This outcome stems from the policy that larger firms, on average, gain more from innovations or lose from their inability to innovate. Established firms with technological leadership protect their market share by investing

* URL: https://www.oecd.org/en/data/indicators/investment-by asset.html?oecdcontrol-c0d5ac5e97-var6=FIXASSET (accessed on 20.07.2024).

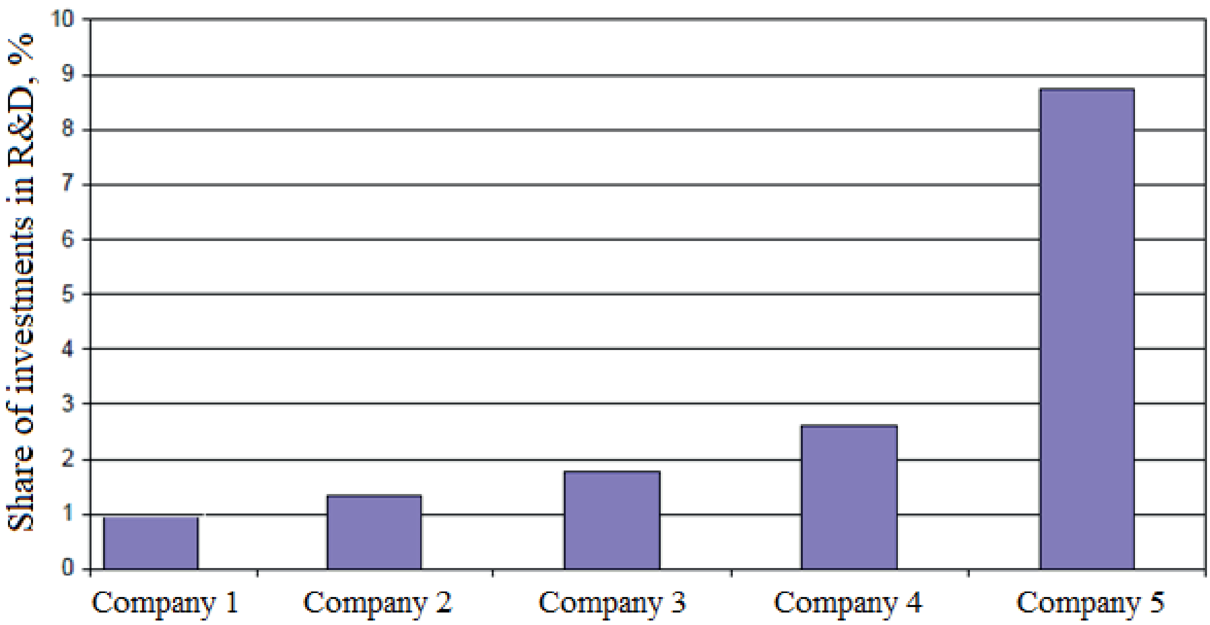

Fig. 1. **The Ratio of R&D Investments Between Companies in OECD Countries Within a Specific Industry, %**
Source: The author' calculations based on OECD statistical data.

more significant resources in R&D than smaller firms.

2. The second "standard example" indicates that R&D expenditures increase the size of profits. It is related to the first but is not necessarily implied by it, and P. Thompson [20] points out that the evidence for the relationship between profits and size is ambiguous. The causal relationship between R&D and profit can be two-way. On one hand, an increase in research and development expenditures may reflect higher expected profits. On the other hand, higher profits may reflect a firm's desire to increase and/or maintain its profitable market share in a competitive environment. Although the first of these two effects is examined in separate empirical studies [21, 22] dedicated to endogenous growth, the reverse direction of the causal relationship from R&D to profitability, emphasized by P. Thompson [20], which he made based on corroborating arguments by P. Geroski [23], is not a feature of these models.

The simple correlation between current profits and R&D expenditures, calculated based on data from OECD countries, is 0.86 when using average levels of profits and investments ranked by firms. This positive correlation largely aligns with the assumptions presented above. Larger and more profitable firms protect their income and profitability by allocating more funds to R&D investments, which subsequently lead to increased profits by maintaining or expanding their competitive advantage. Higher current profits indicate that the firm could lose more by not keeping up with its competitors, thus stimulating more active R&D efforts.

3. The feature of the third "standard example" is that the volumes of R&D investments are proportional to the firm's market share, i.e., the intensity of R&D (usually measured as the ratio of R&D to sales) does not depend on the size of the firm. This case has been the subject of thorough research by various authors, and different econometric estimates have led to different conclusions. For example, in his studies, F. Scherer [24] found that this relationship is close to linear, but for the largest firms, it has some convexity. Furthermore, in their studies, W. Cohen and R. Levin [8] found that most recent studies did not reveal systematic differences in the behaviors of firms of different sizes. In those studies where this was identified, disproportionately high R&D intensity was found in either very small or very large companies [25].

Figure 2 shows the results of calculations and curve fitting using a standard regression equation by the least squares method (LSM) to study the levels of R&D investment based on market share.

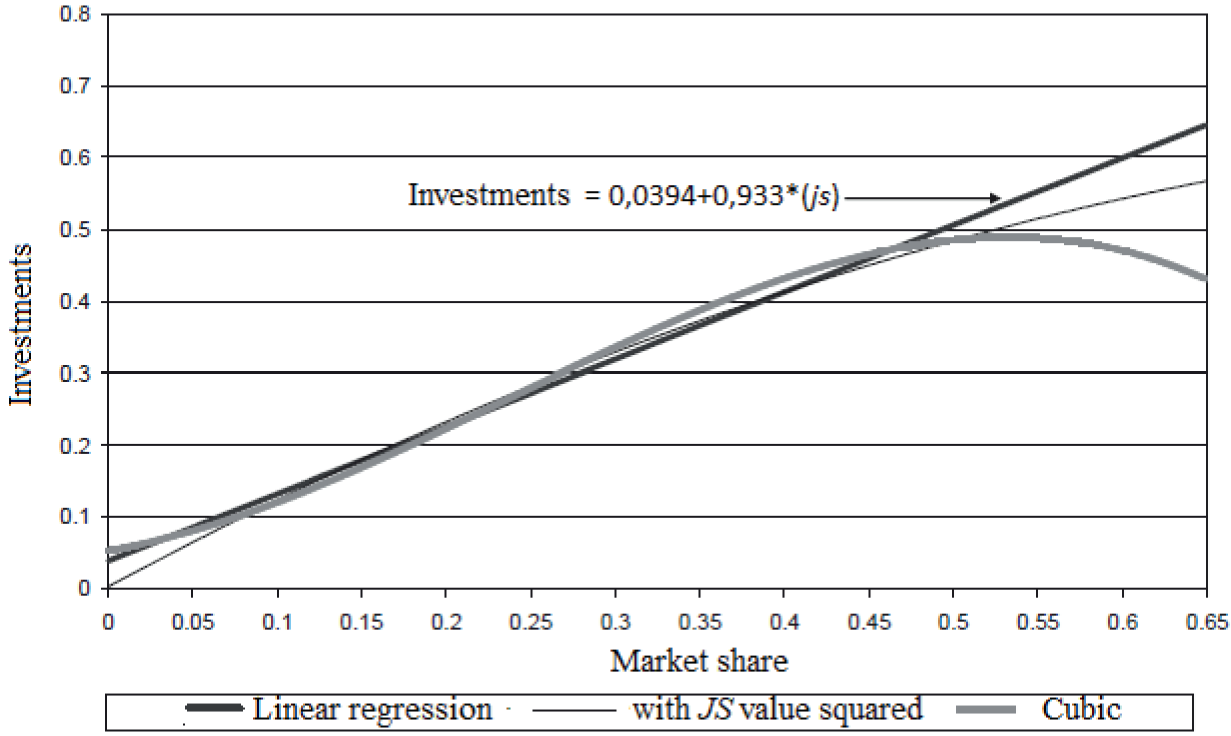

Fig. 2. **Results of the Correlation Calculation Between Current Profit and R&D Expenses of Companies, Calculated Based on Data from OECD Countries**

Source: The author' calculations based on OECD statistical data.

The relationship is almost linear, while the cubic function of market share shows a slight increase for the smallest firms and a concave part for the largest firms. Higher values for the smallest firms indicate that small firms demonstrate a higher level of private innovation. That is, the implicit technological costs for new firms to enter the market, as opposed to the explicit costs associated with exiting the market, are quite high. In cases where exit from the market is not perceived as a threat, small firms invest more than proportionally to their relative production volume. Moreover, the slope of the line of the linear equation (see *Figure 2*) is close to one, indicating that the intensity of R&D is almost, but not quite, independent of the firm's size.

4. The fourth "standard example" indicates that the distribution of R&D intensity is highly uneven. The fact is that existing examples of the ratio of R&D volumes to sales volumes across various industries demonstrate a very stable and highly contradictory dynamic: most firms conduct a small amount of R&D relative to their sales volume or do not conduct any at all, and only a few firms conduct it in large volumes. In particular, in their research, W. Cohen and S. Klepper [26] argue that this asymmetry can be explained by the underlying probabilistic structure of R&D. Moreover, it can be explained even without assumptions that firms of different sizes have different capabilities in conducting R&D. Thus, despite large firms demonstrating lower R&D profitability, W. Cohen and S. Klepper [26] argue that this is consistent with large firms spreading their fixed costs over a broader sales base.

Figure 3 shows the distribution of R&D intensity among companies in OECD countries. The noticeable decline at the lowest levels, but still above zero, is due to the fact that firms with a small market share rarely prefer to invest in R&D at all. Considering that fixed costs in the next period are inevitable, if the firm decides to continue its market presence, the marginal profitability from investments in R&D must exceed a certain lower threshold; otherwise, it will be an inefficient decision. It should also be noted that the model presented by the author assumes some very high values for the ratio of R&D expenditures to sales volume. Nevertheless, the qualitative

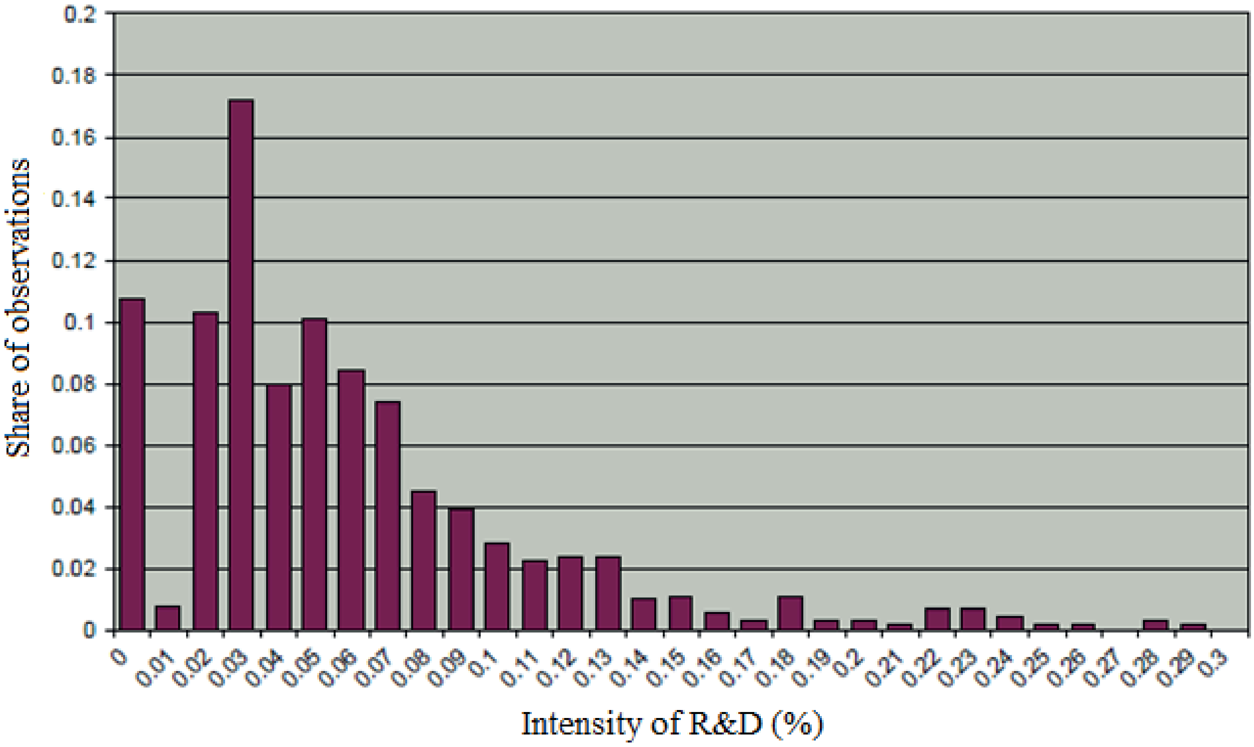

Fig. 3. **Distribution of R&D Intensity Among Companies in OECD Countries (Ratio of R&D Expenditures to Sales Volume)**

Source: The author' calculations based on OECD statistical data.

assessment and quantitative results confirm that the model accurately reflects the key features of the distribution of R&D intensity.

5. The essence of the fifth "standard example" is that the distribution of firms by size is highly varied, and the differences in firm sizes persist. The distribution of firms by size is similar to the distribution of R&D intensity, but, notably, as D. Autretch points out in his research [27], "...practically no other economic phenomenon has remained as stable as the asymmetric distribution of firms by size. It is not only practically identical across all manufacturing industries, but it also remains remarkably constant over time even in developed industrial countries".

6. The sixth "standard example" indicates that the level of risk is negatively related to the age and size of the firm. In particular, in his studies based on the analysis of the U.S. manufacturing industry, T. Dunn [28] found that 61.5% of all new firms exit the market within the first 5 years, and 79.6% of firms exit within 10 years. This fact appears to be quite important when studying the relationship between market structure and economic growth and sharply differs from models within the framework of the "creative destruction" concept, where the risk of market exit is constant and does not depend on the age of the firm. It follows that most new firms "die" relatively quickly, but those that survive endure for a long period of time. It would be natural to assume that this is primarily the result of innovative activity.

7. And finally, the seventh "standard example" states that the turnover rate is inversely proportional to market share concentration. Specifically, in their research, D. Baldwin and R. Caves [29] assert that "an inverse relationship has been established between industry concentration and its average turnover rate, driven by entry into and exit from the market". Although the actual data confirm the assumption of a negative impact of employee turnover on market concentration, the reverse direction of the causal relationship, often used in regression models that also include other indicators of market entry barriers, demonstrates a high degree of multicollinearity, and these results are difficult to interpret as unambiguous. For example, D. Baldwin and R. Caves [29], who use

import volumes as an indicator of competition in their studies, indeed found an increase in turnover in the manufacturing sectors of Canada with higher import volumes, which supports the idea that the causal relationship may be bidirectional.

REVIEW AND CRITICAL ANALYSIS OF MAIN THEORETICAL AND METHODOLOGICAL APPROACHES

If we rephrase the main idea of P. Dasgupta and J. Stiglitz [30], we arrive at the assertion that market concentration and R&D intensity are jointly determined, these are endogenous variables, and causal conclusions in one direction or another, which are made in many econometric studies in this context, can sometimes be misleading. P. Dasgupta and J. Stiglitz [30] convincingly argue that industry concentration measures are not an exogenous explanatory variable for R&D, but other factors jointly determine the equilibrium. However, this does not mean that market structure does not influence R&D. On the contrary, both variables (market structure and R&D intensity) exert reciprocal influence on each other. In a broader sense, the growth rates of the industry or the economy as a whole can be classified in the same category of endogenous variables and provide feedback effects.

In the Dasgupta — Stiglitz model, the central form of competition is scientific activity. To relate this type of competition to market structure, it is necessary to go beyond both perfect and monopolistic competition. In the first case, research is not conducted because it is based on the assumption that all firms have access to the same technology. In the second case, market power is sharply limited by the presence of an infinitely large number of imperfect substitutes, resulting in firms maintaining symmetric investment strategies. However, the question arises whether we can say anything about the intensity of research and, ultimately, the growth of the industry if R&D does not lead to degeneration, i.e., the market structure can change directly as a result of participating in R&D, and firms absorb this effect?

The Dasgupta — Stiglitz model was significantly influenced by the simplifying assumption that all firms in the goods market are homogeneous. Following the Dasgupta–Stiglitz model, a study characterizing industry dynamics with heterogeneous firms emerged. One of the first was B. Jovanovic's study [31], in which the author reveals his approach: introducing heterogeneity at the firm level, allowing new firms to determine efficiency levels based on the overall distribution. However, efficiency remains unchanged, and therefore, R&D is not conducted. Moreover, in their studies, R. Ericson and A. Pakes [4] provide empirical evidence that for the manufacturing sector, the initial size effect disappears over time, which is consistent with Gibrat's law [32] and active search models such as Ericson — Pakes [4], but not with passive learning models such as B. Jovanovic [31] or H. Hopenhayn [33]. The opposite statement may be true for the retail industry. Thus, in this context, in addition to the arguments of Dasgupta and Stiglitz, the key area of competition should be R&D.

Thus, in the Ericson — Pakes model, firms compete with each other through investments in R&D. The model accurately reflects entry/exit indicators in the industry, the age distribution of firms, the ratio of investments to market share [4]. Due to these features and following the logic of the Dasgupta — Stiglitz approach, according to which the R&D sector is the key area of competition, this type of active learning model is best suited for solving the set tasks. However, the initial model cannot account for productivity growth within the industry, and changes are necessary to take this basic model and adapt it to address growth issues within the industry.

But for this, we first need to reveal the essence of the relationship between market structure and endogenous growth theory. Thus, F. Aghion's study [14] is most similar here in that it examines the impact of "aligned" and "unaligned" degrees of competition in the goods market, which essentially serves as an indicator of differences between two firms. In this model, there is a duopoly in each sector with fixed product differentiation, and the level of R&D carried out by firms corresponds to an inverted U-shaped curve, where the intensity of R&D increases as firms converges in quality. The approach presented by the author makes it possible to analyze several steps further, allowing for the presence of more than two firms in each industry and introducing endogenous entry and exit. The approach considered by the author includes P. Peretto's "creative accumulation" model [34] with an oligopolistic competition economy, which implies that the number of firms determines market concentration, firm size, and the intensity of R&D. An increase in the number of firms accelerates economic growth by expanding the market size. However, since profit increase is an internal factor of the firm, an increasing number of firms are slowing down their growth rates, as innovations depend on the average level of R&D rather than on total R&D, as indicated in most other models. The model here also assumes an increase in profit at the firm level, but allows for heterogeneity in firm sizes and, consequently, higher degrees of market structure that must be determined endogenously.

In his study, P. Thompson [21], using an approach analogous to that of P. Peretto [34], but with stochastic elements, allows for the replacement of existing monopolies with firms of arbitrary productivity levels, but the degree of competition within the industry remains limited by "creative destruction". As P. Thompson [20] notes, in an attempt to align the basic model with observed empirical patterns, he assumes that the intensity of R&D does not depend on the size of the firm, and this may lead to a change in the size of the firm that corresponds to empirical data. However, entry and exit from the market are essentially random, and the degree of exit risk does not depend on the age and size of the firm, which contradicts key empirical data obtained in industry studies.

The studies by J. Klette and Z. Griliches [7], J. Klette and S. Kortum [6] are also based on market structure characteristics related to incentives for conducting R&D. The first study uses the concept of differentiated goods. However, the authors abstract from cases of market entry/exit, assuming a random process of "creative destruction" in each product line, which is negatively correlated with the amount of R&D conducted by the firm. Consequently, the incumbent monopolist chooses expenditures sufficient to just prevent R&D competition from entering, thereby eliminating the entry/exit process from it. Thus, the model boils down to competition in R&D and goods, unlike direct competition in R&D between firms in the same industry, as emphasized in the Dasgupta — Stiglitz approach. The second study, however, allows for entry/exit from the market through a stochastic process of "creative destruction", but firms represent a set of goods and thus operate in multiple directions simultaneously. Success in R&D gives the firm an advantage in the market where it currently dominates. This assumption leads to firms not improving their own performance. This reiterates, albeit in a different context, the unattractive feature of models of the "creative destruction" concept, where firms do not conduct R&D or do so to a lesser extent than outsiders, to improve their own performance.

The approach described below consistently complements the examples mentioned above and can explain the behavior of a firm in a dynamic, turbulent environment characterized by the heterogeneity of firms and decisions about entering/exiting the market. Technological innovations are gradual rather than radical, as in the case of F. Aghion's research [14], and thus there is no "creative destruction" as in most endogenous growth models. Dominant firms can be replaced by competitors, but only because they fail to keep up with competitors in R&D, which is a gradual process.

Here we return to the aforementioned Dasgupta–Stiglitz approach and the issue of productivity growth in a dynamic market structure. Unlike the studies we reviewed above, the approach discussed in the paper takes into account the evolution of market structure and defines the market structure and economic growth in aggregate, just as in the Dasgupta–Stiglitz approach. The methodological basis for this study is the dynamic industry model of perfect equilibrium by Nash, developed within the framework of the research by R. Ericson and A. Pakes [4], A. Pakes and P. McGuire [5]. The basic structure of the Ericson — Pakes model is used and extended to ensure endogenous productivity growth. In the Ericson–Pakes model, the marginal production costs for all firms can only take on a finite set of values. In our model, however, the marginal costs can take on an infinite set of values, but the state space remains small and finite because a key property of the profit function is its homogeneity of degree zero in the vector of marginal costs among firms. Thus, the firms' decisions will depend on the relative levels of marginal costs in different firms, rather than on the absolute levels of marginal costs.

The intermediate goods sector is a sector of the economy that includes R&D. Companies choose the level of production, investments in R&D, and decide whether to enter the market if they are currently active, or exit it if they are currently inactive. A dynamic equilibrium is an ideal Markov and Nash equilibrium, which assumes that decisions depend only on the current state, which is the current market structure [35, 36]. The current market structure, more formally defined below, is the total number of firms and the indicator of the relative levels of their marginal costs. Thus, the quantity of goods produced in any period does not have an intertemporal effect that could arise from learning by doing, as, for example, is the case in K. Arrow's research [15]. Dynamic decisions regarding R&D investments, market entry/exit, affect the future marginal costs of each firm and, consequently, alter the market structure in the subsequent period. Since we are directly dealing with market structure here, it was necessary to designate this topic. However, considering the formal constraints imposed on the volume of publications, we tried to limit ourselves to a few theses on the factors influencing the Cournot — Nash equilibrium and R&D investments, as well as the characterization of dynamic problems in the evolution of market structure.

EMPIRICAL ANALYSIS OF THE RESULTS OF EVALUATING THE IMPACT OF R&D SUBSIDIES ON ENDOGENOUS PRODUCTIVITY GROWTH

Since the necessity of the aforementioned evolution of market structure was limited to its role in achieving partial equilibrium for a single industry, demonstrating how growth-stimulating R&D subsidies alter an endogenously determined market structure, we can now proceed directly to answering the main question: "How do R&D subsidies and taxes, typically used in endogenous growth models, affect market structure when the market structure itself is endogenous?". To answer this question, we will proceed with an empirical evaluation of the model at various levels of subsidies and R&D taxes. *Table 1* presents the summary calculation data on the results of the empirical evaluation. As can be seen from *Table 1*, the growth rates of production and market concentration levels increase with subsidies and decrease with taxes. The results of the empirical analysis indicate that changes in production growth rates are directly dependent on corresponding changes in R&D investment volumes. *Table 2* shows the change in the Herfindahl–Hirschman Index (*HHI*), presented as a variance. The *HHI*, the sum of market shares squared, can be transformed into the following equation:

$$HHI = \sum_{k=1}^{K} js_k^2 = \frac{1}{K} + KVar\left(js\right), \tag{1}$$

which demonstrates how the first two moments of the market share distribution among firms contribute to concentration. The *HHI* values presented in *Table 2* are derived from the average market shares of firms ranked from one to six. The values $1/K$ indicate the average number of active firms in the market, while the remainder represents the difference in market shares.

Overall, from *Table 2*, we see those subsidies conditionally "stretch" the distribution of market shares, while taxes "compress" them. The increase in market concentration associated with R&D subsidies (and the decrease with taxes) follows from the dominant effect of the dispersion component. When subsidized, the average value increases (column (4)). It is clear that with subsidies, less efficient firms are willing to stay in the market longer, as the associated costs are lower. Accordingly, from *Table 1,* it can be seen that with increased subsidies, the turnover rate decreases. The increase in the number of active firms itself reduces the market concentration indicator. However, this is sufficiently compensated by the increase in the market share difference. *Table 1* also shows the average number of private innovations implemented by the leading firm. The baseline figure increases from 6.77 to 7.43 with a small subsidy of 10% and sharply rises to 8.81 with a 50% subsidy. With taxes that reduce the incentives of the leading firm to expand its technological leadership, the opposite occurs. As a result, thanks to subsidies, leading efficient firms capture a larger market share, as shown in column (5) of *Table 2*. The last column

Table 1

Results of Calculations on the Impact of Subsidies and Taxes on R&D on Market Structure Changes

Scenarios of state macrofinancial policy	Rate, %	Average value of the HHI index	Turnover rate, %	The level of investment in R&D	The leader's share in total investments	Average number of private innovations introduced by the market leader
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Subsidies	50	0.390	35.8	1.837	0.326	8.81
	25	0.387	50.5	1.503	0.368	7.95
	10	0.386	60.6	1.235	0.398	7.43
Taxes	10	0.412	72.3	0.905	0.434	6.12
	25	0.396	79.5	0.776	0.462	5.75
	50	0.389	86.7	0.582	0.491	4.67
Basic	0	0.382	67.2	1.148	0.412	6.77

Source: The author' calculations based on OECD statistical data.

shows the percentage contribution of the variance component to the *HHI*.

Table 3 shows the impact on the number of firms in more detail. In the baseline case, about 16% of observations involve two or three firms, but when subsidies are 50%, this figure drops to 2%. The introduction of high taxes has the opposite effect, as periods with two or three firms account for 33% of all cases. This effect alone increases the *HHI*, but the compressed distribution of market shares leads to a reduction in variance, which more than compensates for the change in quantity.

Returning to *Table 1*, we note that it also illustrates the dynamic effects caused by macrofinancial policy using one of the turbulence indicators. The last column indicates how many times the position of the firm with technological leadership, i.e., the highest number of private innovations, changed. Taking the baseline figure as an example, the leading firm has a 9.85% chance of losing the top spot in the ranking at any given moment. This indicator is declining due to subsidies, as leading firms begin to expand their technological leadership. Taxes increase the degree of instability, as the leading firm is not inclined to invest in R&D. It can also be noted that as market concentration increases (decreases) due to subsidies (taxes), the level of turnover changes in the opposite direction in accordance with "standard example" 7 provided at the beginning of the paper. It is important to note that the increase in cost for small firms receiving subsidies occurs despite the fact that they are relatively less efficient compared to the leading firm due to the "spread" of distribution.

The conclusions from these results are as follows: R&D subsidies lead to an increase in the number of firms, as well as a rise in the level of concentration as the distribution sphere expands. This effect results in an increase in the price/cost ratio for the leading firm(s). The weighted average difference between price and cost increases under some strategies but decreases under others. In particular, small subsidies can increase the average difference between price and costs, while larger subsidies will reduce it, but at the expense of subsidizing a greater number of firms. At the same time, higher levels of concentration partially offset the positive impact of subsidies on total R&D by reducing the cost of continuing operations for all lagging firms. Finally, subsidies encourage relatively inefficient firms to remain in the market, which is a side effect of subsidies and leads to the hindrance of new firms entering the market, as they face a larger number of competitors and leading firms with greater technological advantages.

Thus, from an industry perspective, the main benefits of R&D subsidies are received by leading

Table 2

Numerical Dispersion Decomposition of the HHI Index

Scenarios of state macrofinancial policy	Rate, %	Average value of the HHI index	Value $1/K$	$KVar(js)$	(5) / (3), %
(1)	(2)	(3)	(4)	(5)	(6)
Subsidies	50	0.390	0.245	0.174	44.6
	25	0.387	0.251	0.168	43.4
	10	0.386	0.256	0.163	42.2
Taxes	10	0.412	0.292	0.142	34.4
	25	0.396	0.299	0.120	30.3
	50	0.389	0.303	0.097	24.9
Basic	0	0.382	0.259	0.153	40.05

Source: The author' calculations based on OECD statistical data.

Table 3

The Impact of Taxes and Subsidies on R&D on the Distribution of Companies

Scenarios of state macrofinancial policy	Rate, %	One company, %	Two companies, %	Three companies, %	Four companies, %	Five companies, %	Six companies, %
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Subsidies	50	0.00	0.37	1.62	40.02	59.75	1.78
	25	0.00	2.01	5.13	36.79	59.42	0.31
	10	0.012	3.72	7.96	31.15	59.94	0.00
Taxes	10	0.03	7.02	11.37	23.89	56.10	0.01
	25	0.03	10.15	14.62	17.61	53.55	0.015
	50	0.03	11.78	18.99	16.87	50.17	0.15
Basic	0	0.032	4.94	11.02	26.57	55.08	0.00

Source: The author' calculations based on OECD statistical data.

firms. This result sharply contrasts with most entrenched growth models, particularly those based on the concept of "creative destruction". In these models, an increase in R&D subsidies leads to a rise in R&D activities from potential entrants, accelerates the pace of "creative destruction", and reduces the expected lifespan of existing monopolists. In this case, subsidies extend the dominance of leading firms, which take advantage of the subsidies to expand their technological leadership, increasing their profitability, profits, and significance in the market.

CONCLUSION

The approach presented in this paper demonstrates ways to achieve endogenous productivity growth within the context of the R. Ericson and A. Pakes model [4]. Moreover, the paper shows that the basic partial equilibrium model is consistent with a number of key empirical regularities found in industry studies

[28], [29, 30], which the authors have identified as desirable properties of the endogenous growth model.

The main objective of this paper was to investigate the macrostructural aspects of evaluating the impact of taxes and subsidies on R&D on endogenous productivity growth. The main findings indicate that subsidies and taxes have a dual effect. As investment goods prices decrease at a certain point in time, more firms are willing to stay in the market even with negative profits. Such expansion of firms reduces market concentration, but, compensating for this effect, leading firms leverage advantages and increase their technological superiority over competitors, which leads to the growth of leading companies' profits. The net effect of concentration is an increase in the volume of subsidies. Nevertheless, subsidies enhance welfare by accelerating long-term economic growth. The obtained results sharply differ from other existing studies on endogenous growth, where R&D subsidies benefit firms exiting the market and increase the speed of "creative destruction". However, in our case, R&D subsidies primarily benefit firms entering the market and reduce the exit rate of leading firms. Although the analysis presented in the paper describes the equilibrium distribution of market structures and the associated industry growth rates, determining the aggregate economic growth rates and how they interact with the market structure requires establishing a complete general equilibrium model, which may be the subject of further research.

The results of this study, based on OECD countries, show that the long-term and short-term impact of state macrofinancial policy on stimulating innovative activity within the framework of endogenous growth theory is evident. They contribute to long-term economic growth, despite the heterogeneity of short-term results. Although even in the short-term dynamics, there are strong endogenous links between innovation, business activity, and economic growth, and all three variables are closely interconnected. Thus, as primary macroeconomic measures that the government of the Russian Federation should undertake, the stimulation of R&D, innovation, and business activity can be highlighted in order to take advantage of the obvious causal relationships between these variables in the short term.

Moreover, stimulating innovation through macrofinancial policy tools is a viable long-term doctrine, regardless of how we define these variables. Thus, the empirical results obtained from studying the experience of OECD countries confirm the idea that long-term economic growth in the Russian Federation will depend on the effectiveness of the interrelationship between macrofinancial policy and the national innovation system, which promotes both a dynamic business culture and an innovative climate in all regions. Strong support for innovation and business activity will strengthen the competitiveness of existing sectors of the economy, and the interaction between these two variables will lead to the emergence of new points of economic growth.

REFERENCES

1. Aref'ev N.G., Aref'ev A.I. Economic growth and ideas. Preprint WP12/2010/02. Series WP12. Moscow: SU HSE; 2010. 56 p. (Scientific Reports of the Laboratory of Macroeconomic Analysis). URL: https://www.hse.ru/data/2010/06/23/1220399037/WP12_2010_02f.pdf (In Russ.).
2. Polterovich V.M. The theory of endogenous economic growth and equations of mathematical physics. *Zhurnal Novoi ekonomicheskoi assotsiatsii = Journal of the New Economic Association.* 2017;(2):193–202. (In Russ.). DOI: 10.31737/2221–2264–2017–34–2–11
3. Polterovich V.M., Henkin G.M. Evolutionary model of interaction between the processes of creation and borrowing of technologies. *Ekonomika i matematicheskie metody = Economics and Mathematical Methods*. 1988;24(6):1071–1083. (In Russ.).
4. Ericson R., Pakes A. Markov-perfect industry dynamics: A framework for empirical work. *The Review of Economic Studies*. 1995;62(1):53–82. DOI: 10.2307/2297841
5. Pakes A., McGuire P. Computing Markov-perfect Nash equilibria: Numerical implications of a dynamic differentiated product model. *The RAND Journal of Economics*. 1994;25(4):555589. DOI: 10.2307/2555975
6. Klette J., Kortum S. Innovating firms and aggregate innovation. *Journal of Political Economy*. 2004;112(5):986–1018. DOI: 10.1086/422563

7. Klette T.J., Griliches Z. Empirical patterns of firm growth and R&D investment: A quality ladder model interpretation. NBER Working Paper. 1998;(6753). URL: https://www.nber.org/system/files/working_papers/w6753/w6753.pdf
8. Cohen W., Levin R. Empirical studies of innovation and market structure. In: Schmalensee R., Willig R., eds. Handbook of industrial organization. Amsterdam: North-Holland; 1989;2:1059–1107. DOI: 10.1016/S 1573–448X(89)02006–6
9. Schmalensee R. Interindustry studies of structure and performance. In: Schmalensee R., Willig R., eds. Handbook of industrial organization. Amsterdam: North-Holland; 1989;2:951–1009. DOI: 10.1016/S 1573–448X(89)02004–2
10. Solow R.M. Technical change and the aggregate production function. *The Review of Economics and Statistics*. 1957;39(3):312–320. DOI: 10.2307/1926047
11. Henkin G.M., Shananin A.A. Mathematical modeling of the Schumpeterian dynamics of innovation. *Matematicheskoe modelirovanie = Mathematical Models and Computer Simulations*. 2014;26(8):3–19. (In Russ.).
12. Sharaev Yu.V. Theory of economic growth. Moscow: SU HSE; 2006. 254 p. (In Russ.).
13. Schumpeter J. Theorie der wirtschaftlichen Entwicklung. Leipzig: Verlag von Duncker & Humblot; 1911. 548 p. (Russ. ed.: Schumpeter J. Teoriya ekonomicheskogo razvitiya. Moscow: Eksmo; 2007. 400 p.).
14. Aghion P. Innovation and growth from a Schumpeterian perspective. *Revue d'économie politique*. 2018;128(5):693–712. DOI: 10.3917/redp.285.0693
15. Arrow K.J. An extension of the basic theorems of classical welfare economics. In: Neyman J., ed. Proc. 2nd Berkeley symp. on mathematical statistics and probability (July 31-August 12, 1950). Berkeley, CA: University of California Press; 1951:507–532.
16. Barro R.J. Determinants of economic growth: A cross-country empirical study. NBER Working Paper. 1996;(5698). URL: https://www.nber.org/system/files/working_papers/w5698/w5698.pdf
17. Cantner U., Vannuccini S. Elements of Schumpeterian catalytic research and innovation policy. *Industrial and Corporate Change*. 2018;27(5):833–850. DOI: 10.1093/icc/dty028
18. Castellacci F., Natera J.M. Innovation, absorptive capacity and growth heterogeneity: Development paths in Latin America 1970–2010. *Structural Change and Economic Dynamics*. 2016;37:27–42. DOI: 10.1016/j.strueco.2015.11.002
19. Cowan R., Foray D. Evolutionary economics and the counterfactual threat: On the nature and role of counterfactual history as an empirical tool in economics. *Journal of Evolutionary Economics*. 2002;12(5):539–562. URL: 10.1007/s00191–002–0134–8
20. Thompson P. The microeconomics of an R&D-based model of endogenous growth. *Journal of Economic Growth*. 2001;6(4):263–283. DOI: 10.1023/A:1012761811439
21. Fagerberg J., Verspagen B. Innovation, growth and economic development: Have the conditions for catch-up changed? *International Journal of Technological Learning, Innovation and Development*. 2007;1(1):13–33. DOI: 10.1504/IJTLID.2007.015017
22. Freeman C. Technology policy and economic performance: Lessons from Japan. London: Pinter Publishers; 1987. 155 p.
23. Geroski P.A., Machin S., van Reenen J. The profitability of innovating firms. *The RAND Journal of Economics*. 1993;24(2):198–211. DOI: 10.2307/2555757
24. Scherer F.M. Innovation and growth: Schumpeterian perspectives. Cambridge, MA: The MIT Press; 1984. 310 p.
25. Howitt P., Mayer-Foulkes D. R&D, implementation, and stagnation: A Schumpeterian theory of convergence clubs. *Journal of Money, Credit and Banking*. 2005;37(1):147–177. DOI: 10.1353/mcb.2005.0006
26. Cohen W.M., Klepper S. The anatomy of industry R&D intensity distributions. *The American Economic Review*. 1992;82(4):773–799.
27. Audretsch D.B. Innovation and industry evolution. Cambridge, MA: The MIT Press; 1995. 224 p.

28. Dunne T., Roberts M.J., Samuelson L. The growth and failure of U.S. manufacturing plants. *The Quarterly Journal of Economics*. 1989;104(4):671–698. DOI: 10.2307/2937862
29. Baldwin J., Caves R. International competition and industrial performance: Allocative efficiency, productive efficiency, and turbulence. In: Cook G., ed. The economics and politics of international trade. Vol. II. London: Routledge; 1998:57–84.
30. Dasgupta P., Stiglitz J. Industrial structure and the nature of innovative activity. *The Economic Journal*. 1980;90(358):266–293. DOI: 10.2307/2231788
31. Jovanovic B. Selection and the evolution of industry. *Econometrica*. 1982;50(3):649–670. DOI: 10.2307/1912606
32. Sutton J. Gibrat's legacy. *Journal of Economic Literature*. 1997;35(1):40–59. URL: http://www.econ.uiuc.edu/~econ536/Papers/sutton97.pdf
33. Hopenhayn H.A. Entry, exit, and firm dynamics in long run equilibrium. *Econometrica*. 1992;60(5):1127–1150. DOI: 10.2307/2951541
34. Peretto P.F. Cost reduction, entry, and the interdependence of market structure and economic growth. *Journal of Monetary Economics*. 1999;43(1):173–195. DOI: 10.1016/S 0304–3932(98)00040–3
35. Helpman E. R&D and productivity: The international connection. NBER Working Paper. 1997;(6101). URL: https://www.nber.org/system/files/working_papers/w6101/w6101.pdf
36. Kaldor N.A. Memorandum on the value added tax, submitted to the Committee on Turnover Taxation in July 1963. In: Essays on economic policy. vol. I. London: Duckworth and Co.; 1964:266–293.

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