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ARTICLES

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Jan L. Bednarczyk[1]

Monetary Policy Targets and Macroeconomic Equilibrium. Some Theoretical Remarks

Abstract:

Purpose*: The article attempts to systematize the strategies undertaken by individual countries (groups of countries) after the 2007+ crisis with regard to stabilizing prices and supporting economic recovery. It is about highlighting the strengths and weaknesses of particular types of strategies as well as opportunities and threats related to their implementation.*
Methodology*: In the theoretical analysis, three types of economies were distinguished, using as a criterion the orientation of a given economy towards securing price stability or supporting economic recovery. The classical dynamized AD-AS model, commonly used in macroeconomics, and the SWOT analysis were used as a research tool.*
Findings*: The basis for differences in the approach of economic authorities of individual countries to the problem of stabilizing prices or supporting economic recovery is the mandate of the central bank. Depending on the type of strategy implemented by the central bank, individual countries and groups of countries react diametrically to exogenous shocks, which results in different results in terms of economic growth and employment.*
Practical Implications*: The results can be utilized by central authorities (central banks) in formulating assumptions and forecasts of monetary policy.*
Originality / Value*: The paper contains an original division of countries / groups of countries due to their orientation in the field of medium-term stabilization policy. The analyzes of these countries are also original, having no equivalent in the world literature on this subject.*

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***JEL codes**: E31, E58, E61 ..*

***Paper type**: Theoretical research article*

1. Introduction

No major simplification is not made by stating that the essence of the dispute that has been going on in economic theory and in the theory of economic policy for several decades boils down to answering the question whether the medium-term stabilization policy should focus solely on securing price stability, or it should support the achievement of other goals, in particular securing the means to accommodate the economic recovery and improve the situation on the labor market (Friedman, 1968, 2007; Akerlof, Dickens, & Perry, 1996; Bernanke, Laubach, Mishkin, & Posen, 2001). This dispute takes different forms, in different places and with different intensity (Ball, 2013; Ito, 2016; Bednarczyk, 2012; Bednarczyk, Brzozowska-Rup, 2018). During it, spectacular changes of positions (e.g. Blanchard, Dell'Ariccia, & Mauro, 2010; Blanchard, Dell'Ariccia, & Mauro, 2013) and politics took place; e.g. the hitherto supporters of full price stabilization became supporters of creeping inflation, as was the case, for example, in the Japanese economy (increasing the inflation target), or in countries that developed "traditionally" in conditions of high inflation and began to implement policies aimed at suppressing it (Mexico).

The number and influence of the supporters of both options also evolved. While at the beginning of the 1990s, there was almost unanimity among the theoreticians and practitioners of central banking on the importance of securing price stability as a necessary and practically sufficient condition for long-term economic growth, situation chnged after the crisis at the turn of the 2000s, and especially after the 2007+ and COVID – 19 crises. Supporters of using all available monetary policy tools to revive the economy began to gain more influence (even in conservative circles of central banking leaders), justifying slightly greater tolerance for price increases (Powell, 2020; Bank of England, 2021; Clarida, 2021). The nature of the dispute over the way economic policy is formulated is reflected in the strategies implemented by individual countries (groups of countries) with regard to stabilizing prices and supporting economic recovery (ECB (a), 2021; ECB (b), 2021; PBoC, 2021; Board of Governors of the Federal Reserve System, 2021). As mentioned above, these strategies may change over time depending on the results achieved. Therefore, it is important to trace

the mechanisms and channels of their impact, especially in periods of strong exogenous shocks.

2. Methods

In the theoretical analysis, three types of economies were distinguished, using as a criterion the orientation of a given economy towards securing price stability or supporting economic recovery. Featured:

1) low – inflation oriented economies,
2) moderate - inflation growth oriented economies,
3) higher - inflation growth oriented economies.

The classical dynamized AD-AS model, commonly used in macroeconomics, and the SWOT analysis were used as a research tool.

3. Theoretical analysis

re.1) The main feature of low-inflation oriented economies (see the example of the euro-area economy) is readiness to give up economic growth if the result of this growth is exceeding the set low inflation target. Such unambiguous determination of priorities was explicitly included in, among others, the Treaty on the Functioning of the European Union (EU 2008) , Statute of the European System of Central Banks and of the European Central Bank (EU 2012) , where in Chapter 2, Article 2 of the latter it is stated that “the main objective of the ESCB is maintaining price stability. Without detriment for price stability (emphasis added), the ESCB supports general economic policies in the Union …”.

Moreover, even if real inflation is below the set target but inflation expectations show an upward trend, then, it is quite likely that in this type of economy monetary policy can become stricter in fear of triggering an “uncontrolled” inflation process which in the long run can threaten achieving the set target. In the low-inflation oriented economy, in accordance with the logic of the Taylor rule, clear asymmetry can occur as regards the reaction of the authorities to the increased inflation rate and higher unemployment rate. Even a slight move upward of the inflation rate (by few basis points) – especially when real inflation overlaps or slightly exceeds the set inflation target – causes tightening of monetary policy (triggers a series of increases in official interest rates), whereas a higher (even considerably) unemployment rate, (of several hundred basis points) is ignored by the authorities which explain this increase, e.g. by changes in the NAIRU levels (Bednarczyk, 2013) or provide other equally abstract causes. The way in which this type of economy reacts to exogenous shocks, both negative and positive, is also important.

The way in which the anti-inflation-oriented economy reacts to a negative exogenous shock resulting, e.g., from a considerable increase in prices of raw materials is presented in Figure 1.

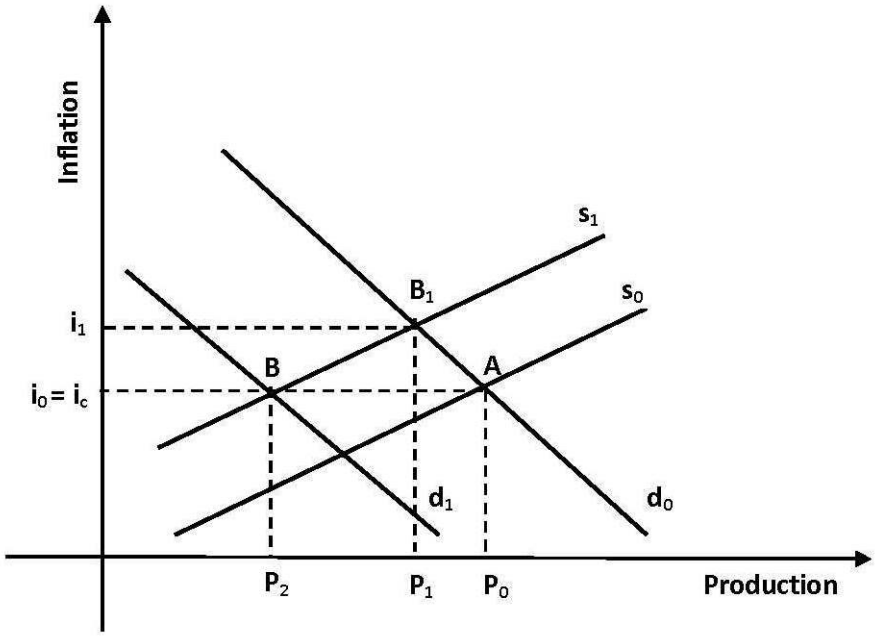

Figure 1. Reaction of low-inflation economy to a "negative" price shock.
Sourece: Author`s own research.

The initial equilibrium at point A corresponds to output at the level P_0 and inflation of i_0, i.e. equal to the adopted inflation target ic. Let us assume that a sudden and considerable increase in prices of raw materials (e.g. oil) takes place in the global market which, considering dependence of a given economy on their imports, will cause an increase in production costs and prices. This corresponds to a shift of the supply curve from s_0 to s_1 and equilibrium from point A to point B_1. However, the monetary authorities of a country following the strategy of maintaining inflation close to the set inflation target will tighten monetary policy to prevent inflation growth. As a result of a decline in global demand (a shift of the demand curve from d_0 to d_1), the economy will reach equilibrium at point B which corresponds to the output level P_2, lower than the initial level P_0 and lower than the level P_1 which would result from the use of a price rise as an external shock absorber. The difference between the output levels P_1 and P_2 is the cost incurred by the economy for maintaining price stability. It is the flexibility of changes in the output levels in relation to price changes (position

of the supply curves) that determines how big this cost is in relation to achieved benefits. A more horizontal position of these curves can cause that the benefits achieved in the field of price stability (the difference between i_1 and $i_0 = i_c$) can turn out to be quite small, whereas production losses can be significant.

The reaction of the low-inflation oriented economy to a "positive" price shock can be equally unfavorable for economic growth (Figure 2).

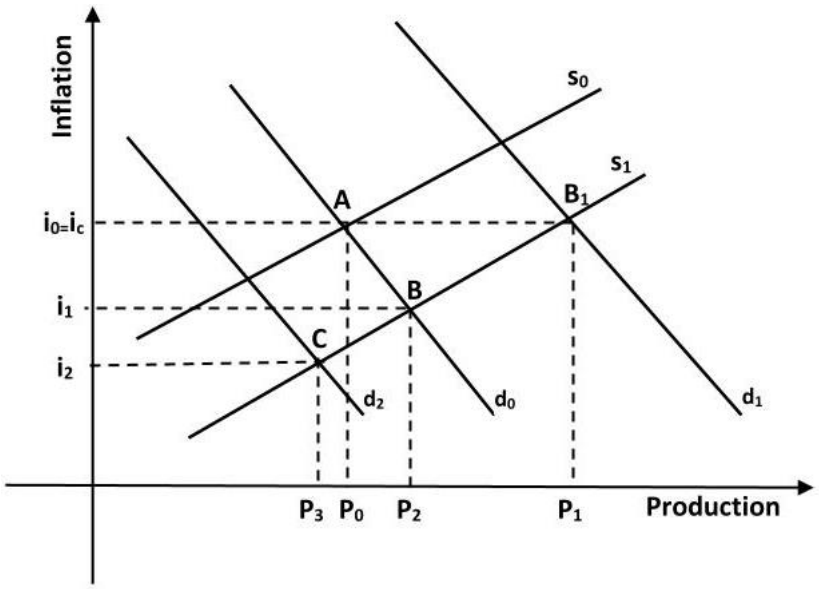

Figure 2. Reaction of the low-inflation oriented economy to a "positive" price shock.

Source: Author's own compilation.

Let us assume that point A indicates the situation of initial equilibrium which corresponds to the output level P_0 (at the reserve production capacity) and inflation i_0 equal to the inflation target i_c set by the authorities. Let us also assume that the economy becomes a beneficiary of a "positive" price shock related, e.g. to lower prices of raw materials or an inflow of cheap labor force reducing production costs (a shift of the s_0 curve to s_1). Theoretically, lower production costs can cause two types of reaction from the authorities: 1) maintaining a neutral (or even restrictive) character of monetary policy which results in an equilibrium at point B,

2) initiating reduction of interest rates to revive demand which means a shift of the demand curve d_0 to d_1 and the equilibrium from point A to point B_1.

Considering the fact that the authorities try to keep inflation at level i_c that is higher than real inflation (thus, they have a degree of freedom to support a recovery), it seems more probable that they will adopt strategy 2. Yet, in practice, in the low-inflation oriented countries, variant 1 is chosen. It happens so because while pursuing the set inflation target and emphasizing a negative effect of each price increase on the market participants' assets and quality of life, the authorities will perceive "undershooting" the target as a lesser threat for the economy than a threat posed by the situation when inflation exceeds the set target. They will interpret an inflation decrease as temporary and not requiring any correction of monetary policy. Naturally, such an approach of the authorities exposes "real" economy to a significantly increased risk which results from the possibility of transforming inflation expectations into deflation expectations, increasing the expected long-term real interest rates and pushing the economy into a long-lasting "low inflation trap" with all its negative consequences (Bednarczyk, Misztal, 2016; Ito, 2016; Xiaochuan, 2016).

re 2) A different "philosophy" of development is implemented by the moderate-inflation growth oriented economy. In the legislation of these countries defining the central bank goals, the tendency towards growth maintenance is given the highest priority but price stability is taken into account as an important factor determining its attainment. A specific feature of the development strategy implemented by the moderate-inflation growth oriented countries is their pragmatic and not doctrinal approach to the way in which monetary policy is carried out. In the policy of both countries one can find some elements of the "hybrid" version of inflation targeting (certainly more in the policy of the Federal Reserve System), yet, the character of undertaken activities is determined mainly by their consistency with the current practice, adequacy to the current conditions in which the economy functions and usefulness for satisfying its needs.

The moderate-inflation growth oriented countries react differently to external supply-side shocks in comparison to the above described cases of reaction to these shocks by the countries implementing tough anti-inflation strategies. Figure 3 illustrates the case of reaction to a negative supply shock. The initial equilibrium at point A corresponds to the inflation rate i_0 and output P_0. The effect of a supply curve shift from s_0 to s_1 (due to a supply-side shock) will be a tendency towards the equilibrium at point B which corresponds to higher inflation (i_1) and lower output (P_1). The authorities note a growing inflation rate and, at the same time, try to calm down expectations (forward guidance can be one of the methods)

while taking decisive measures aiming at counteracting the supply-side shock effects. They can be of both pro-supply nature (tax reliefs, increased expenditure on R&D) and pro-demand nature (increased access to credits and lower credit costs, increased state expenditure, etc.). As a result of the authorities activities and market mechanisms, the supply curve will move to s_2 and the demand curve – to d_1. The equilibrium will be found at point B1,

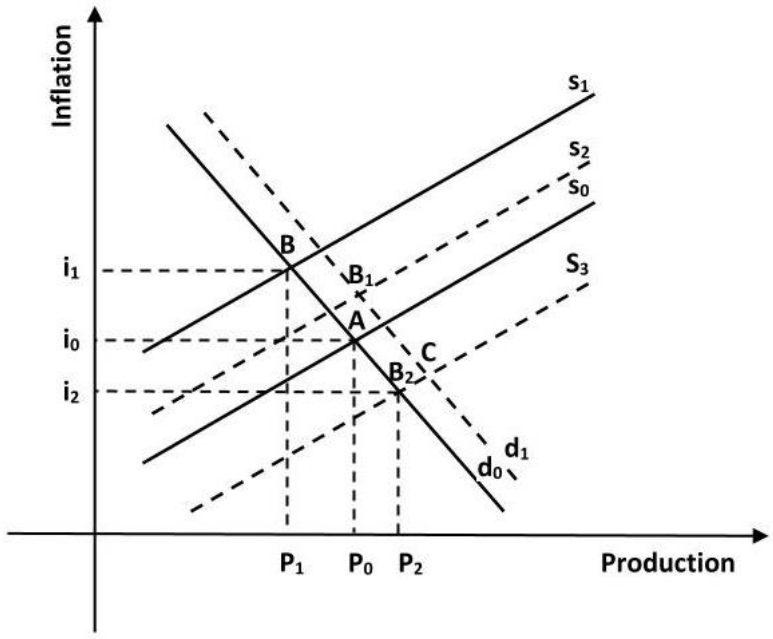

Figure 3. Reaction of the moderate-inflation growth oriented countries to a "negative" supply-side shock.
Source: Author's own research.

which corresponds to the same output level which was noted before the shock. The inflation rate which in "the transitional period" was higher than at the beginning can be reduced depending on the extent to which the authorities will manage to put inflation expectations under control. If the return to the output level from before the crisis is more the effect of pro-supply moves reducing production costs (the supply curve shifts towards s_3), then the price increase rate can achieve values lower than those before the crisis, and output – higher levels (equilibrium at point B_2).

Also in the case of a "positive" supply-side shock the reaction of the moderate inflation growth oriented economies will be more favorable for the prospects of the general macroeconomic equilibrium than in the case of the low inflation oriented economies (Fig. 4). Let us assume

that due to a large decrease in prices of raw-materials (oil), the supply curve will start to shift downwards to the right towards s_1, which corresponds to the tendency towards increased output (due to lower costs and generally better effectiveness of management) and lower inflation indices. The authorities supporting growth and striving for a better situation in the labor market (in China this can mean including subsequent groups of rural population in labor market mechanisms) will perceive a temporary decline in inflation as a chance to implement pro-supply factors of the business cycle recovery (e.g. by easing credit policy). Obviously, the degree of the production capacity utilization and the balance of payment situation are very important for the possibility of taking advantage of this chance. However, if the economy does not function in the circumstances close to the

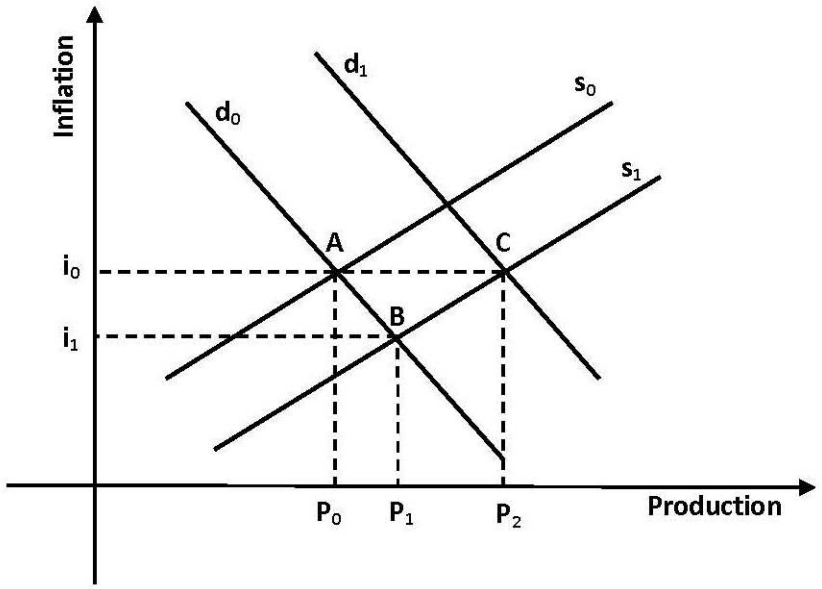

Figure 4. Reaction of the moderate-inflation growth oriented economy to a positive supply shock.
Source: Author's own research

Full utilization of its production capacity and the situation of the balance of payment does not seriously deteriorate, it is highly probable that as a result of the authorities activities and market mechanisms, the economic equilibrium will eventually appear at point C, which corresponds to a decisively higher output level than that before the shock and the same inflation rate. A positive difference between output levels P2 and P1 is the evident gain of the moderate-inflation growth oriented economy

in relation to the low-inflation oriented economy, resulting from a possibility of implementing a more flexible and active income policy.
re. 3) The specificity of the higher-inflation growth oriented countries (economies) stems from the facts that, firstly, these countries experience longer or shorter episodes of high (India) or very high (Brazil) inflation and, secondly, that they understand price stability differently from the low or even moderate inflation growth oriented countries.

Moving on to the analysis of reactions of the higher-inflation growth oriented economies to supply-side shocks, we should keep in mind the evolution of their monetary policy in the course of the last decades as the inflation processes were fading globally. In connection with lower global inflation indices, also the costs of the disinflation process initiated in those countries gradually decreased; this was supported by stabilization or even a drop in import prices. Thus, the said countries could focus more on pursuing their inflation targets without risking excessive losses in the fields of production output and employment. The "classical" model of the reaction to an exogenous price shock in the higher-inflation growth oriented economy, causing an unexpected increase in production costs is presented in Figure 5. Let us assume that initially the economy is in the state of equilibrium at point A which corresponds to output level P_0 and inflation i_0.

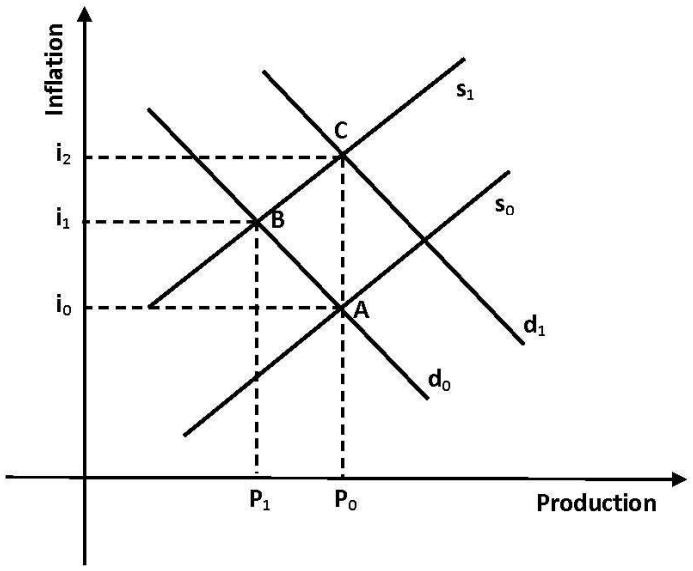

Figure 5. Reaction of the higher-inflation growth oriented economy to a "negative" price shock
Source: Author's own research.

A considerable increase in import prices causes a shift of the supply curve to s1 and economic equilibrium curve to point B which corresponds to a lower output level (P_1) and lower employment. The authorities willing to support economic growth and prevent an increase in unemployment can choose a strategy consisting in compensation of higher import costs to companies by increased access to bank credits and reduced credit costs, increased public procurement, etc., which will result in increased internal demand values and a shift of the demand curve to position d_1 and economic equilibrium to point C. The new equilibrium will enable the return of output and employment to the pre-supply shock levels, which can be perceived as a success of the authorities' policy. Yet, this success will be achieved at the expense of high inflation (i_2).

Moving on to the analysis of the reaction of the higher-inflation growth oriented economy to a "positive" exogenous shock, it must be noted that this type of economy can use all assets of the expansive income policy to revive economic growth. Like in the case of the moderate-inflation growth oriented economies, here also the limits of economic expansion are determined by the degree of utilizing production capacity and the situation of the balance of payments. Characteristic features of these economies are often substantial resources of unused labor resources, high ratio of investment in fixed assets and a large capacity for absorption of foreign direct investments which flow in with an intention to take advantage of the recovery. Both these factors act toward removal (or mitigation) of barriers to growth and strengthen the boom.

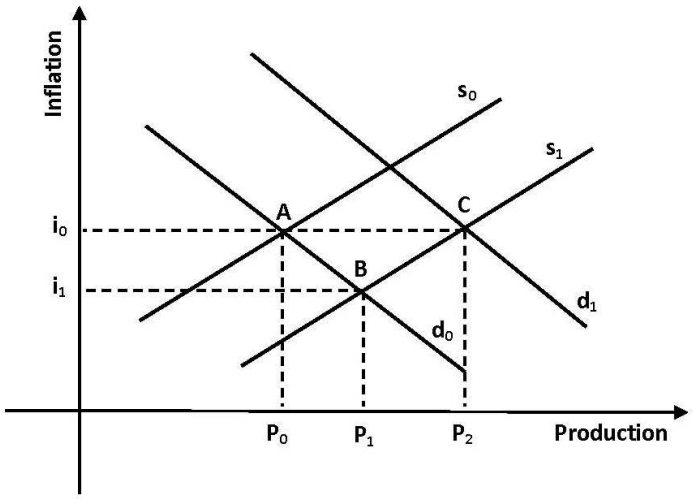

Figure 6. Reaction of the higher-inflation growth oriented economy to a "positive" price shock.
Source: Author's own research.

Possible changes in the macroeconomic equilibrium in the higher-inflation growth oriented economy are presented in Figure 6. A shift of the supply curve to s_1 and economic equilibrium to point B accompanies output growth to the level of P_1 with a simultaneous drop in inflation (i_1). The authorities interested in following long-term goals of "economic and social progress" or "indispensable economic growth", will not take advantage of a temporary inflation drop to anchor inflation expectations at a lower level (e.g. by tightening monetary policy) so as to allow the inflation rate to reach the values close e.g. to the values noted in the countries of low inflation (2 - 3%), but instead they will initiate actions supporting economic growth up to the moment when inflation reaches "traditional" or even temporarily higher inflation values. In Figure 6 this corresponds to a shift of economic equilibrium to point C which in turn corresponds to a higher than initial output level (P_2).

4. Discussion

Table 1 presents the elements of the SWOT analysis of the above-mentioned strategies of the medium-term stabilization policy. The differences in the effects they cause depend, inter alia, on on the severity of exogenous shocks affecting individual economies, the degree of society's tolerance of price increases, the effectiveness of market mechanisms as well as the speed and scope of a given economy's response to changes in macroeconomic policy (Bednarczyk, 2018). The theoretical analysis

Table 1. SWOT analysis of selected strategies of the medium-term stabilization policy

		Strenghts	Weaknesses	Chance	Threats
1	A strategy focused on keeping inflation low	- low inflation - real income protection - strengthening of the exchange rate	- low pace of economic growth - the threat of deflation - zero lower bound risk (ZLB) - threat of a deficit of the balance of payments	- improvement efficiency of market mechanisms	- lack of an adequate response to exogenous shock - the occurrence of the contagion and fragmentation effects at the financial markets.
2	Strategy of promoting economic growth at a moderate level of inflation	- gradual increase in nominal income from work and capital - gradual increase in real production - "normal" level of interest rates	- the possibility of non-acceptance of moderate inflation by market participants - increase in inflation expectations - emergence of demands for wage increases	- good economic situation on foreign markets - no threat of a stronger destabilization of the global financial system	- exogenous shock, e.g. a sharp increase in energy resources
3	The strategy of supporting economic growth at a higher level of inflation	- fast growth of nominal income and internal demand - faster production and employment growth where the current level of potential production is much lower than the potential level	- the possibility of an uncontrolled increase in prices (launching a wage and price spiral), - currency depreciation	- using the increase in prices and the exchange rate as a "cushion" limiting the impact of external shocks on the economy	- lowering the level of foreign investors' confidence in the domestic economy

Source: Author`s own research.

carried out above indicates the existence of a high probability of coexistence between a policy of low (a priori defined) inflation target and a low economic growth rate. One of the reasons for this coexistence may be the too weak and poorly targeted response of this policy to exogenous shock. A policy aimed at promoting economic growth amid moderate inflation has much greater possibilities to overcome exogenous shocks. Although the effect of this policy are slightly higher inflation rates, it allows to avoid, for example, the threat of the development of the deflation and stagnation process and the Zero Lower Bound problem (Bednarczyk, Misztal, 2016).

The feasibility of a strategy based on promoting economic growth at higher inflation levels depends mainly on the degree of capacity utilization. In the case of high capacity utilization, further stimulation of demand may lead to acceleration of price growth, sharp depreciation of the currency exchange rate, capital outflow and other negative phenomena that may significantly reduce the effectiveness of the government's response to exogynous shocks.

5. Conclusions

Drawing the final conclusions from the above considerations on the strategy of central banks' operation in the conditions of turmoil in global markets, causing effects on the macroeconomic balance (especially price stability) in individual countries (groups of countries), it should be noted that:

1) the monetary policy strategies undertaken by the main participants of the world economy, as the leading method of medium-term economic policy, differ quite significantly,

2) the differences are based on the mandate of the central bank: it may oblige the bank to strictly adhere to a fixed inflation target, or to control inflation in order to create the best possible conditions for economic growth,

3) there are significant differences in the practical understanding of the nature of price stability; in industrialized countries (the euro area, the United States, Japan, United Kingdom) 2% inflation is assumed as an approximation of full price stability, while in other large economies of the G20 (China, India, Brazil) much higher inflation is tolerated as meeting the requirements specifically understood stability,

4) depending on the implemented strategy, individual countries and groups of countries react diametrically to exogenous shocks, which may result in different results in terms of economic growth and employment,

5) the strategy chosen by the authorities, depending on the duration of its implementation, may have a strong influence on the awareness of market participants regarding its mechanisms and affect the expectations

and course of real economic events, which in turn may reduce the effectiveness and usefulness of traditional tools of state influence on macroeconomic equilibrium (e.g. the effectiveness of changes in short-term official interest rates) and, more broadly, the effectiveness of a medium-term stabilization policy.

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ARTICLES

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Anna Mężyk[1]

RAILWAY EFFICIENCY. METODOLOGICAL ASPECTS

Abstract

Improving market competitiveness and economic efficiency was the objective behind the demonopolisation and liberalisation of the railway sector in the European Union. Achieving this objective remains important and crucial to the development of a single rail transport market. The transport performance and financial results of the sector under the new, separative organisational structure of railways in the EU is the result of the action of many different actors, private operators and public entities. This significantly complicates the development of uniform and clear comparable performance evaluation indicators for the sector and makes comparative analyses difficult. Moreover, the specific situation of railways in the EU as a tool for implementing environmental and social policy may conflict with the requirements of financial efficiency. The article presents determinants and methods of measuring railway efficiency proposed by researchers and practitioners.

JEL: L380 – Public Policy; L920 – Railroads and Other Surface Transportation

Key words: railway, restructuring, efficiency, determinants

Paper type*: Theoretical research article*

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1. INTRODUCTION

The process of restructuring the railways in the European Union began in the early 1990s. The main decisions to change the organisational structure of the sector involved separating the companies managing railway infrastructure from those carrying out transport activities. Access to business activities in the sector was also opened up to private companies, while maintaining requirements in terms of professional competence and safety, which means that operators must obtain a licence

The measures taken were intended both to improve the economic situation of undertakings in the rail transport sector and to improve the market position and attractiveness of railways as a means of transport. Improving economic efficiency is a topical and important issue, both for railway undertakings and for statEs, owners and managers of assets, mainly the rail infrastructure network. Striving for the best possible results from their activities is obvious in the case of managers and owners of railway undertakings. Their survival in a competitive market environment depends on attracting customers and generating profits. For the European Union, however, the railways are not only an important and large economic resource, but also a tool for achieving social and environmental policy objectives. Poor use of the existing potential has negative economic consequences, including above all the burden on public finances of the need for constant maintenance of the expensive and inefficient rail infrastructure network and other assets.

In the light of climate change, it is increasingly important for the economies of the European Union to meet growing transport needs in an environmentally friendly and energy-efficient manner, in accordance with the idea of the European Green Deal. Rail transport offers such opportunities. The European Union's transport system, outlined in the 2011 White Paper on European Transport Policy, is to be an efficient, effective and environmentally friendly system (EC, 2011). Rail transport is to be an essential component of this system, offering high quality services at affordable prices. It is therefore fundamental for the efficiency and development of rail transport to achieve lower production costs and a better service offering that meets customer expectations. This objective has guided the restructuring, demonopolisation and liberalisation of the railway market in the European Union. Intra-industry competition and new private operators were expected to provide a sufficient pro-efficiency stimulus. However, the effects of structural changes have not been fully satisfactory so far, which means that it is necessary to continue to search for factors that could increase the efficiency of the entire sector and railways' market shares.

Research carried out by practitioners and scientists confirms the theses of transport economics that the key to improving rail efficiency is a significant increase in demand for freight and passenger transport or the restriction of service to profitable lines, market segments and types of service. The public tasks of railways and the social and environmental policy objectives of EU countries, which railways are supposed to serve, are at odds with the requirements of financial efficiency. In view of the expanded role of railways in the European Union, it would also be appropriate to apply extended efficiency criteria, supplemented by the expected non-financial effects of railways, and covering all the entities making up the fragmented structure of the sector.

Due to the variety of objectives and forms of economic activity carried out in the railway sector and the regulatory involvement of the state, the assessment of railway sector efficiency is complex and must take into account various factors: technical, production, political and marketing. The aim of this article is to present methods for measuring railway efficiency..

2. RAILWAY RESTRUCTURING AND EFFICIENCY

Increasing the railways' share in transport required a fundamental change in the structure of the sector, which made it necessary for scientists and politicians to design fundamental restructuring processes. The guiding idea behind the restructuring of the railways was and is the creation of conditions for railway undertakings to achieve sustainable economic efficiency, ensuring them a stable position on the transport market.

According to the theoretical foundations, the way to achieve the objectives set for the restructuring of rail transport is to transform the monopolistic structure of this sector into a structure allowing the market mechanism and competition to operate. At the same time, it is necessary to identify and regulate those processes in rail transport which create chronic deficits and inefficiencies in operations. This required the identification of several areas of restructuring activities, including (Mężyk, 2011, 77-84):

- the new approach and regulation of natural monopolies in rail transport,
- the principles of a competitive market,
- the external conditions necessary to achieve sustainable efficiency in railway undertakings,
- adaptation of the hitherto integrated railway undertakings (which are state-owned) to the new rules for operating under competitive conditions on the transport market.

The classical economic approach to the operation of railways assumes that the marginal cost of producing services decreases as the scale of production and the scope of the processes performed increases. The desire to fully realise potential economies of scale was thus the original rationale during the development phase of rail transport for consolidating rail processes under private or public control. Another rationale, relevant to public authorities in the context of regulatory activity, was the intention to control actual or potential abuse of market power as a result of the existence of a natural monopoly and the distribution of economic benefits among consumers. A change in the hitherto principles of organisation of railway transport was therefore associated with the need to confront the assumption that railway transport as a whole constitutes a natural monopoly. Closer analysis of this assumption led to the recognition that, in fact, only the management of railway infrastructure, including train operations, exhibits features of a natural monopoly, while the remaining area, i.e. freight and passenger transport processes, may be separated as independent activities subject to market laws.

Separation of transport companies from the complex structure of the only one company in the country made it possible to open access to operations to other interested entrepreneurs and, consequently, to create a rail transport market with all the advantages and positive effects of the market mechanism and competition. This necessitated the design of appropriate market and regulatory solutions. As far as the regulation of railway infrastructure was concerned, such solutions were sought which, without diminishing the advantages of natural monopoly (the lowest possible service production costs), would at the same time provide effective control over the negative aspects of its operation - primarily its social ineffectiveness (limiting production volumes, increasing prices). With regard to the organisation of the transport market, solutions were needed that would ensure a model similar to that of perfect competition - non-discriminatory access to the market and to production factors (equal access to exercise the profession, to production factors - the railway network, rolling stock, skilled workforce) and equal conditions for competing on the market. An important factor which objectively determines the effectiveness of rail transport is the distance over which it is carried out. This is another area which, under European conditions, requires legal changes at inter-state level. The extension of transport distances, especially for freight, became politically possible with the implementation of the single European market at the beginning of the 1990s, while technical harmonisation of railway systems remains a problem.

The creation of a competitive rail market has also involved the transformation of state-owned enterprises, subordinated to public service requirements and thus to socio-political decisions, into enterprises operating on a commercial basis. As a result, the smooth operation of the rail transport sector depends on a number of factors as follows:
- technical - on the quality and accessibility of rail infrastructure,
- legal - regarding regulation of access to the market and to the profession,
- market - with respect to rules of operation and principles of market access, strength and forms of intra-industry competition, attractiveness of services to customers
- political - in terms of functioning of an open transport market and access to services and principals in other EU countries.

European legislation clearly defines the role of public authorities as the owner of the railway network, the market regulator and the entity responsible for financial stability of the sector.

3. OPERATORS ON THE RAILWAY MARKET IN POLAND

The process of demonopolisation and liberalisation of the railway market in Poland, initiated by the provisions of the Act on Commercialisation and Restructuring of the State Enterprise "Polish Railways" of 8 September 2000, has led to a significant increase in the number of operators active in the sector. The total number of licensed operators is 122, with some of them being infrastructure owners and also performing the functions of infrastructure managers. Some operators have licences to operate both freight and passenger services. Table 1 shows the list of passenger rail operators, according to their share in the number of passengers carried and transport work performed in 2019.

Tab.1. Rail passenger operators in Poland in 2019 and their market share

No	Operator	By the numer of passengers	By transport performance
1	Polregio	26,46%	20,21%
2	Koleje Mazowieckie	18,49%	9,70%
3	PKP Intercity	14,55%	52,78%
4	PKP SKM	12,83%	4,49%
5	SKM Warszawa	6,56%	1,50%
6	Koleje Śląskie	6,07%	3,27%
7	Koleje Dolnośląskie	4,20%	3,09%
8	Koleje Wielkopolskie	3,62%	1,99%
9	ŁKA	1,79%	0,83%
10	WKD	2,62%	0,60%
11	Koleje Małopolskie	1,93%	1,12%
12	Arriva RP	0,69%	0,37%
13	Others	0,19%	0,04%

Source: UTK, Statystyka przewozów pasażerskich, 2020

Among the 12 major carriers, only one, Arriva RP, is a private carrier. Two companies, PKP Intercity S.A. and PKP SKM, are public companies owned by the 100% state-owned PKP S.A. group. These two companies carried more than 36% of passengers in 2019 and performed 57% of transport work, measured in terms of passenger-kilometres. A special form of ownership is represented by the passenger carrier Polregio, which is owned by the Industrial Development Agency J.S.A.(majority shareholding, 50% plus one share) and by the local governments of all provinces. As of 1 December 2021, Polregio was granted the status of a joint stock company. Other passenger transport companies included in the table are entities owned by voivodeship self-governments.

This market structure, with the dominance of public companies, entitles this part of the railway sector to be treated as the public sector. However, the operating conditions of each company are different and highly varied, which significantly hinders comparability of their transport performance. The main factors which have a significant impact on the performance of a railway undertaking in passenger transport are the density of the railway infrastructure network, the degree of industrialisation and urbanisation of a region, the number of people living in a given province. Location of big cities and agglomerations creates favourable conditions for their service by railway transport due to mass and regularity of transport needs.

The mass of transport needs is the main determinant of the effectiveness of rail transport, both in passenger and freight transport. The second significant factor is the transport distance. The greater the distance, the lower

the fixed costs of rail and rolling stock per unit of distance. Significantly more private carriers are active on the rail freight market (Table 2).

Tab.2. Cargo railway undertakings in Poland in 2020 and their market share

No.	Operator	By mass transported	By haulage [tkm]
1	PKP Cargo S.A.	36,63%	40,56%
2	DB Cargo Polska S.A.	16,89%	5,09%
3	Lotos Kolej sp. z o.o.	5,62%	10,36%
4	PUK Kolprem sp. z o.o.	3,81%	2,52%
5	PKP LHS sp. z o.o.	3,68%	4,94%
6	CTL Logistics sp. z o.o.	3,55%	4,31%
7	Orlen Kol-Trans S.A.	2,92%	4,21%
8	Freightliner PL sp. z o.o.	2,46%	3,30%
9	Pol-Miedź Trans sp. z o.o.	1,83%	1,44%
10	Rail Polska sp. z o.o.	1,55%	1,47%
11	PKP Cargo Service sp. z o.o.	1,26%	b.d.
12	CD Cargo Poland sp. z o.o.	1,29%	1,76%
13	PCC Intermodal S.A.	1,23%	1,77%
14	Captrain Polska sp. z o.o.	1,15%	1,72%
15	Ciech Cargo sp. z o.o.	1,13%	0,94%
16	Inter Cargo sp. z o.o.	1,05%	2,32%
17	KP Kotlarnia S.A.	0,94%	b.d.
18	Ecco Rail sp. z o.o.	0,91%	1,39%
19	LTE Polska sp. z o.o.	0,85%	1,03%
20	JSW Logistics sp. z o. o.	0,80%	0,50%
21	Railpolonia sp. z o.o.	0,60%	0,60%
22	Metrans Polonia sp. z o.o.	0,58%	0,70%
23	Eurotrans sp. z o.o.	0,58%	b.d.
24	Karpiel sp. z o.o.	0,61%	0,76%
25	Orion Rail Logistics sp. z o.o.	0,502%	b.d.
26	Eurasian Railway Carrier sp. z o.o.	0,49%	b.d.
27	Bartex Plus sp. z o.o.	0,27%	0,44%
28	Logistics & Transport Company sp. z o.o.	0,28%	0,48%
29	STK S.A.	0,10%	0,10%
30	Pozostali	6,47%	5,28%

Source: UTK, Statystyka przewozów towarowych, 2020

Among the nearly 30 carriers that count on the market, only two entities belong to the PKP S.A. group. However, in 2020 they carried more than 40% of the freight mass and performed 46% of the haulage (tonne-kilometres). Two more entities, Lotos Kolej and Orlen Kol-Trans, belong to public companies, Lotos Group and PKN Orlen Group.

4. CONCEPT AND ASPECTS OF RAIL TRANSPORT EFFICIENCY

Efficiency is one of the basic terms in economics. It means the result of actions taken (or planned), described by the relation between the effects obtained and the outlays incurred. In its most general formulation, effectiveness refers to many economic phenomena, including management and organisation. A narrower concept is economic efficiency, which is measured using synthetic indicators of resource productivity.

In order to define the concept of rail transport effectiveness and to establish indicators for measuring it, it is necessary to define both the types and volumes of expenditure incurred and the expected results. In the European Union, this is problematic because the infrastructure management function has been assigned to a separate body that cannot provide transport services alone. In the countries of the European Union, the railway infrastructure network within national borders, including supply and safety systems, is in public ownership, with only a few sections of individual lines or sidings remaining in private ownership.

The principle of the separating structure of the European rail market is, that operators gain access to the railway network against payment. Under European law, it is the duty of the States, the owners of the infrastructure, to ensure that the infrastructure managers' expenditure on maintaining and modernising the railway network is balanced against their revenue. However, income from the sale of routes does not cover the full costs of maintaining and modernising the network, for which reason infrastructure managers also receive subsidies from the state. Full coverage of the costs of the rail network from the sale of route access is also not required by law or policy; on the contrary, it is recommended that the costs of the rail route should be competitive with the costs of the motorway and include, for example, only marginal social costs.

The financing of new projects is a separate issue and is based on public funds. The amount of expenditure incurred is related to the extent of maintenance work, network maintenance standards and the train path parameters offered. The result of these activities is the offer of train paths with a specified speed and capacity. However, the actual sale of train paths and therefore the financial effects of the infrastructure manager's activity depend on demand from the operators. The activities of the infrastructure manager, expenditure incurred in developing the railway network and maintaining network quality standards have a direct and significant impact on the extent and quality of services provided by carriers but may not be reflected in the level of income of the manager. As a result of the regulations introduced providing access to the railway network, many private railway undertakings have appeared on the European market, accounting for a significant proportion of traffic. The expansion of private

operators has primarily affected the freight market. However, the largest freight operators in Europe are still state-owned companies. In passenger transport, on the other hand, public, state and local authority operators dominate in most European countries. All companies operate according to the same principles, fully autonomously, on the basis of licences.

Railway undertakings' expenditure on railway operations consists mainly of wage costs, the cost of access to infrastructure and expenditure on running rolling stock. As a result of these expenditures, freight and passenger transport is carried out, generating revenues and profits. However, the volume of transport does not depend only on carriers. The attractiveness of an offer to a customer is influenced, for example, by the time of transport, which in turn depends on the condition of available infrastructure and permissible train speed. On the other hand, the number of passengers in passenger transport carried out as a public good service is related to the spatial and temporal range and frequency of the transport offer, which is significantly influenced by the size of public subsidies. Subsidies for passenger transport activities covered in Poland from public funds of the government and provincial self-governments may be earmarked for subsidizing the costs of transport implementation or for the purchase of new vehicles. Thus, there are three distinct groups of stakeholders bearing the costs of operating the railway and expecting satisfactory results. These are:

- public authorities (government and provincial governments),
- infrastructure manager
- carriers.

The expectations of these three groups of entities with regard to economic performance are partially convergent, primarily with regard to the highest possible volume of freight and passengers transported at minimum cost. These expectations coincide with the formula of classical productive efficiency. However, other effects are also important for public authorities, which can include:

- providing all stakeholders, citizens and companies, with transport services of general interest, with adequate accessibility (spatial, temporal), affordability (price) and quality. This implies maintaining an adequate network size and quality of service, as well as sufficiently low fares, which may be incompatible with a purely business-oriented approach,
- development of the sector, through investments introducing innovation and technical progress,
- optimisation of use of the railway infrastructure through cooperation with other transport branches,

- environmental effects - reduction of environmental pollution from transport sources by taking over a part of transport performed by road transport, and as a result - increase of railway market share
- political effects - creation of common, single market in the international dimension, ensuring public ownership of key railway resources.

The above-mentioned expectations of public authorities with regard to the railways are in many cases in conflict with the requirements of purely productive efficiency. In the light of current European Union transport policy, however, economic objectives should be given priority. An increase in the efficiency of rail transport will consequently benefit everyone - owners of railway undertakings, users of services and taxpayers. It will also ensure conditions for the stable development of this branch of transport, which will also make it possible to achieve environmental and social objectives. This approach reflects both the point of view of the state, for which the public interest is important, and the priorities of railway undertakings.

The assessment of rail transport efficiency must therefore take account of the fact that the costs of rail transport production result not only from the quantity of resources consumed but also from the quality parameters achievable and expected by customers and from the need to meet the social, environmental and political objectives set for the railways by the State. There is a relationship between financial and efficiency objectives and those of a social nature. However, these objectives can be given different weights, e.g. financial and cost efficiency are usually rated higher than other outcomes. Each state, when undertaking the process of evaluating railway efficiency, should formulate its own set of criteria for this evaluation, in addition to criteria of productive efficiency.

Taking into account the objectives set for railways, it can be seen that one of the basic effects, which is fully agreed on and expected by all parties, is an increase in the share of railways in servicing the transport market (Mężyk, 2011). Thus, the quantitative development of freight and passenger transport is the most important measure, realistically reflecting the effects of the functioning of the sector and the convergence of the interests of the state, carriers and customers, individual and business entities.

An increase in the volume of transport does not, however, indicate an increase in the financial effectiveness of a carrier or the whole sector. An important aspect of the negative or positive evaluation of the changes in this measure in the context of the entity's efficiency is the analysis of the conditions of its implementation, including exogenous conditions, such as the condition of the economy, the change in the goods structure or transport behaviour patterns, the development of the logistics structure and cooperation with other transport branches, remaining outside the influence of the initiative of a single entity.

5. MODELS FOR MEASURING RAILWAY EFFCIENCY IN THE FIELD OF PRODUCTION THEORY AND PRODUCTION FUNCTIONS

Efficiency measurement models in the area of production theory and production functions aim to indicate whether and to what extent producers' performance deviates from their expectations (Holvad, 2020). The application of methods such as efficiency measurement models to the railway sector poses some difficulties because it requires taking into account the specific characteristics of the railway market. The specifics of the railway market include:

- the existence of a natural monopoly on access to rail infrastructure,
- the existence of network externalities,
- economies of density, scale and scope associated with the provision of rail services.

Efficiency analysis can be considered as one of the techniques available to determine the ability of entities to transform inputs into outputs. These analyses can be carried out at different levels of aggregation, in individual departments within a company, for the whole company over time, in cross-sections of companies and whole sectors. The outcome of the production process depends on various factors, on the effort expended as well as on capabilities, including exogenous factors. In the case of railways, as in other modes of transport, the analysis of external factors and conditions is very important, since transport is a secondary need that occurs in response to the primary demand of the economy and society. If this demand is negligible, the transport system is idle.

Given the importance attributed to railways in balancing the transport system, the competitiveness of the railways is critical to achieving this objective. The competitiveness of railways is closely related to their attractiveness in meeting transport needs, which in turn influences their efficiency and effectiveness. A very important factor is the existence of equal conditions of competition between transport modes operating in a given market segment. Analysis of the railway sector's efficiency may broaden knowledge of the factors causing its lack and indicate the directions of change, which would be important for railway operators and public authorities. Analysis of the determinants of productivity and efficiency of railway undertakings should give public authorities a better understanding of which regulatory and policy instruments are important to promote productivity in the railway sector. According to Holvad, there are three main approaches to analysing the ability to transform inputs into outputs (Holvad, 2020). These are:

- partial productivity indicators,
- averaged production functions,
- limit-based methods (parametric and non-parametric methods).

Productivity indicators are widely used in assessing the ability of entities to convert inputs into outputs. Productivity indices are basically concerned with the relationship of one output to one input factor. However, it is difficult to apply this evaluation method to multiple products or multiple inputs, where it becomes necessary to define weights to calculate the total products and inputs, or to distribute inputs across products. This is the situation of rail services.

Approaches to better capture the complexity of railway operations in Holvad's view are econometric techniques such as Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) (Holvad, 2020). DEA method, i. e. Data Envelopment Analysis, is a semi-parametric method of analysing the results achieved by a selected economic entity or a group of such entities with a similar profile of activity, forming a sector of economy, for example the passenger or freight transport sector.

The DEA method makes it possible to identify those entities or sectors with the best performance characteristics (Dorosiewicz, 2015). DEA method uses the concept of relative efficiency, estimated by comparing the efficiency of the examined unit with the efficiency obtained in other available and taken into consideration units. A test unit is considered to be efficient if with the use of available production technologies it is not possible to improve the results obtained in that unit. In practice, it is necessary to construct a production function that describes the relationship between inputs and outputs.

In the transport sector, it is often difficult to obtain detailed, comparable data, including the specification of effects and, above all, of inputs, which makes it difficult to apply the mentioned techniques to efficiency analysis. However, given the opportunity to improve railway efficiency, for example through benchmarking, comparability of data is important.

6. J. SWIER GENERAL RAILWAYS COST-BENEFIT MODEL

One attempt to comprehensively capture the costs and effects of railway operations in the mixed public-private structure of European railways is the model proposed by J. Swier, a manager at Pro Rail, the rail infrastructure management entity of the Netherlands (Swier, 2012). Swier concludes that the organisational structure of railways in the EU is conducive to a number of positive developments, such as a greater number of operators, improved quality of service, competition for customers and a clear definition of the roles of public authorities and private operators. However, the downside is that no one knows how all the costs and revenues

in the rail sector are related, or who contributes and to what extent to the overall effect of rail operations, which ultimately benefits shippers and passengers.

The overall finances of railways as a mode of transport consist of a mix of revenues and subsidies, as well as operating costs, capital expenditures and access charges, obtained and borne by all the entities that make up the product of railways - transport services. Swier proposes two models, which organise these relationships in the railway sector and help to understand them:

- a quantitative cost/benefit model,
- a matrix of common quality targets for the whole railway sector as a complement.

The starting point for the construction of a quantitative model is the assumption that the degree of profitability of rail transport can be estimated by knowing all costs and all revenues. Swier estimated the costs and revenues associated with managing the railway network and transport activities for each line on the network it manages, assigning them to a unit of total transport work (the so-called "transport unit", Transport Unit, which is the sum of transport work in passenger and freight transport, used by the International Union of Railways UIC). The following groups of financial categories are included in the model:

- four types of costs: operating costs for passenger services, freight services, cost of access to infrastructure, infrastructure maintenance costs,
- two types of revenue: revenue from the sale of services and public subsidies.

All costs and revenues have been identified for each line in the network and related to one line kilometre, thus giving a picture of how much it costs to maintain one line kilometre and what revenue that line generates per kilometre. The analysis of the relationships obtained allowed the formulation of conclusions explaining the relationships between costs, revenues and utilization rates of each line and the entire Dutch railway network. As an example of evaluating the effectiveness in terms of network utilization, the following conclusions can be cited, as formulated by Swier:

- as the use of the network increases, the overall cost of rail transport also increases; but revenues are growing faster,
- costs of little-used regional lines are low, but revenues from them are even lower; in this situation it is necessary to increase revenue without increasing costs (by increasing the number of passengers),

- for many lines, even with relatively high utilisation, competition 'for the market' is better than competition 'on the market'. Splitting the operation of this line as a result of competition between the two operators results in a rapid decline or even disappearance of profit, as revenues decline faster than operating costs.

The calculations carried out by J. Swier made it possible to determine the break-even point in terms of the number of TU transport units per 1 km of line, in two variants: in one case only for transport operations, and in the second variant for infrastructure management and transport performance together. Moreover, J. Swier has estimated external effects connected with railway operation (social costs and benefits), according to methodology recommended by the European Union for cost/benefit analysis of investment projects. According to these guidelines, social outcomes included (EU, 2014):

- travel time savings due to reduction of congestion on motor roads,
- reducing the number of accidents on car roads,
- (possibly) less air pollution due to less car traffic,
- (possibly) less interference with the landscape, through less construction of road infrastructure,
- (possible) lower production costs,
- (possible) economic incentives for employment and the economy.

Jan Swier has shown that the social benefits of railway operation exceed the costs of public subsidies, which in effect fully justifies the policy of supporting railways by the state. The calculations performed are for the Netherlands, but the proposed methodology can be applied to any country. The results of the calculations make it possible to gain knowledge about the total costs and revenues incurred by all groups of entities on individual lines, as well as about the factors that influence the preservation or loss of efficiency. Such knowledge is important, if only for the sake of making rational decisions on continuing or abandoning the operation of particular lines. However, much of the data could only be obtained through studies and surveys commissioned in advance by the infrastructure manager. On the other hand, other data, especially those concerning the operating costs of private carriers, were not available and were estimated indirectly.

7. METHODOLOGY FOR ASSESSING RAIL PERFORMANCE RECOMMENDED BY ITF

Research and discussion on rail efficiency research methodologies is regularly undertaken by the International Transport Forum, an intergovernmental organisation dealing with transport issues, administratively linked to the OECD but politically independent (63 members). Studies undertaken by ITF think-tanks on thIS issue have addressed the problem of how to measure rail performance or efficiency - both in the sense of comparing one railway with another (cross-sectional comparison) and in the context of assessing changes in railway performance as a result of policy interventions (time series). Many studies have highlighted the significant impact of the specificity of national railway systems on their effectiveness, which is very difficult to quantify and not easy to change, thus making it difficult to compare the performance of the systems in a reliable way. Among the elements that make up the national characteristics of rail systems are:

- the historical background to the physical layout of the railway network and its organisation,
- wars and the impact of their effects on railway infrastructure,
- topographical conditions - it is more costly to build and maintain infrastructure in mountainous areas,
- settlement structure and population density influencing the degree of network utilisationthe specifics of national railway policy: varying degrees of acceptance of railway subsidies and debt, political decisions to make costly investments without assured financing for their continued operation, or political decisions to finance railways on the basis of their performance.

Among the characteristics that differentiate railway systems, we should also mention the technical characteristics of the network, such as the degree of electrification, the number of switches and crossings, railway hubs, stations, the degree of automation, the share of dedicated lines, etc. The questions posed by the ITF experts were: What is the appropriate level of detail at which an analysis should take place? What data must be available so that decision makers can compare railroad performance, assess the impact of past interventions, and estimate the benefits of future initiatives?

In the light of the ITF experts' opinion, technical efficiency, which involves maximizing the results obtained from a set of inputs, or allocative efficiency, understood as the creation of an optimal set of inputs to maximize results, is dominant (ITF, 2019). However, it is difficult to adopt a single efficiency formula that is equally relevant to business owners or rail operators,

government, users or the regulatory body. Operators will define efficiency in terms of infrastructure access and cost. Users are interested in availability, reliability or speed of carriage. For the regulator, it will be important to assess both technical and allocative efficiency, and different information will be needed to examine both parameters. Consequently, the ITF experts believe that the simplest approach to conceptualising and measuring rail performance is to derive Key Performance Indicators (KPIs) from published data. This may be sufficient to develop a simple but balanced scorecard. To monitor performance, both cross-sectional indicators (which compare systems) and time series indicators (which measure change over time) are needed.

However, both types of data acquired should be treated with some caution. Cross-sectional data carry the risk of comparing systems where outputs or inputs are defined differently. For time series indicators, there is a risk that the categorization of inputs or outputs may change from year to year. Past performance data must therefore be adjusted to reflect changes, e. g. in organizational structure or accounting standards. For cross-sectional comparative analysis, data from different systems must be standardized. Measuring the performance of a rail system using demand/supply indicators (such as the number of passengers carried per total number of train-kilometres) can also be misleading. These indicators are influenced by factors such as topography, historical evolution, etc. and they may be insignificant without adjustment for exogenous factors.

The performance indicators recommended by the ITF combine the parameters of the rail product, i. e. freight work expressed in tonne-kilometres and passenger-kilometres, with the main cost and revenue drivers of railway undertakings, which are:

- the degree of utilisation of the network,
- the degree of utilisation of rolling stock,
- productivity,
- cost/income ratios.

For the purpose of analysis of effectiveness of railway operations, the main categories of costs and revenues, occurring in the two basic processes which make up transport production, i. e. infrastructure management and transport performance, were identified. It has been assumed that the main infrastructure costs are investment, maintenance and renewal costs, while the costs of transport operations are rolling stock and labour costs. The revenues of the infrastructure manager consist of the revenues from infrastructure access charges and public subsidies, while the revenues of the operator consist of ticket sales and also public subsidies. Unfortunately, conducting financial efficiency analyses is often hampered by the lack of availability of complete financial data. The efficiency

of the railway system is mainly influenced by the intensity of use of the network and rolling stock, due to the large share of fixed costs. The network utilisation indicator is the number of TUs (sum of tonne-km and pkm) per one line kilometre (TU/km), while the rolling stock utilisation indicator is the number of TUs per 1 train kilometre. The higher the resource utilization, the higher the revenue generated.

In view of the complexity of the problem and the difficulty in accessing reliable data, experts from the International Transport Forum recommend using simple indicators to collectively analyse rail performance. A basic aggregate picture of railway efficiency can be obtained using a small set of cross-sectional and time series data, forming a limited set of key performance indicators. The data needed are generally routinely collected by rail organizations.

8. BALANCED SCORECARD

The simplest approach to developing a scorecard is to develop key performance indicators (KPIs) from published data. The indicators proposed by the ITF relate to the basic parameters of size and scale of operation, which form the basis for the development of basic efficiency and productivity indicators. This will enable the development of a basic balanced rail performance scorecard that would consist of six types of indicators (Bente, Thompson, 2014). These are:

1. System Scope,
2. Use of assets,
3. Use of human resources,
4. Operating Results,
5. Financial Results,
6. Customer-focused service quality.

The advantage of a simple balanced scorecard is the availability of data. These are data relating to:

- passengers: number of passengers, passenger-km, gross tonne-km for passenger trains, number of train-km, passenger coaches, electric and diesel multiple units,
- freight: tonnes carried, tonne-kilometres, gross tonne-kilometres of freight carried, number of train kilometres for freight trains and freight wagons,
- common or shared assets: locomotives, manpower, kilometres of line,
- financial and economic performance: total operating costs; total operating revenue, passenger revenue, freight revenue.

The efficiency and productivity indicators developed from the above data are:

- average passenger journey length (pas. km/number of passengers) and average freight journey length (tonne-km/number of tonnes),
- share of passengers in traffic units (TU): lane-km /(lane-km+tonokm),
- share of passengers in gross tonne-km: quotient of the mass of passenger trains to the total mass of trains,
- share of passenger transport in total operational work (passenger train km/(passenger train km+freight train km),
- traffic density: TU/km of line, gross tonne-km/km of line and poc. km/km of line
- performance of passenger carriages: pas. km/(train weight: passenger carriages + DMU+EMU traction units),
- wagon capacity: tonne-km/wagon
- Locomotive Use: TU/(locomotive + MU factor),
- labour productivity: TU/number of employees, tkm gross/number of employees; number of train km /l. employees.
- operating ratio: operating costs/operating income. is a widely used measure of financial performance and an indicator of a railway's ability to meet its financial obligation
- average revenue per lane km and per tonne-km.

Both cross-sectional indicators (comparison of systems) and time series indicators (change over time) will be needed to monitor performance. Time series analysis allows the rail system's performance to be compared to previous years, but no matter how good the railroad's performance may seem in comparison to itself, it may still be relatively inefficient compared to other railroad companies. Using cross-sectional (time-series) data analysis, one could attempt to assess whether some railroad companies consistently rank at the top of the distribution in terms of efficiency in many of these areas and over time. Both types of data should be treated with caution. Time series indicators are subject to the risk that the categorization of inputs or outputs changes from year to year and can be strongly affected by major organizational or economic changes. A key weakness of using KPIs is that different measures produce different results (e. g. cost per train-km and cost per track-km) and it is not clear which measure should be used.

The proposed approach has the advantage of simplicity, but there are also caveats. The simplest approach to benchmarking is to compare the railway to its own past performance. However, even in this case, all data and parameters may not be the same. Past financial performance data may need to be adjusted as a result of organizational changes within the company, changes in accounting standards or policies, inappropriate

application of accounting standards, or external policy decisions where the owner is the state. There may also be periods when rail investment or infrastructure maintenance is not up to scratch, causing problems to accumulate in future.
Also, exogenous, cost-determining factors may be a much greater cause of variation in performance than railroad management. Of the three main stakeholders, the decision maker (regulatory authority, state) has the most power to determine external conditions. In passenger transport, the growth in traffic can be attributed predominantly to changes in the economy. The vertical division in the rail sector's organisational structure increases transaction costs related to coordination, internal accounting and negotiation, although the exact magnitude of these costs is subject to debate.

How complicated data collection can be is shown by the example of Poland. The preparation of performance indicators for the railway sector in Poland will require the collection of transport and financial data from 122 licensed carriers providing passenger and freight services as well as from 17 infrastructure managers, public – state, self-government and private ones.

9. CONCLUSIONS

The efficiency of railway transport operations in the European Union is a topical and important issue, both from the point of view of the practice of railway companies and from the perspective of EU Member States. The basic issue for further development of rail transport is to reduce production costs and to prepare a better offer of services meeting customers' expectations. This objective has guided the processes of demonopolisation and liberalisation of the railway market in the European Union from the outset. Intra-industry competition and new private carriers in the market were expected to provide sufficient pro-efficiency incentives. However, the effects of structural change are not yet fully satisfactory (Mężyk, 2011, p.406).

The provision of railway services is multi-dimensional and, in economic terms, a railway undertaking is a multi-product undertaking. It is a very capital-intensive activity where various economic phenomena such as economies of scale and density or manifestations of natural monopoly occur. This complexity makes it difficult to draw up an efficiency description that is equally relevant from different points of view or for all stakeholders: government, network users (operators), rail service users.

In most countries, large subsidies of public money are paid for rail infrastructure and passenger transport. An important question for the authorities in such a situation is whether these subsidies are spent efficiently or how they can be reduced, e. g. by increasing the efficiency

of the beneficiary. Rail operators are interested in production efficiency and users of rail services in their utility. Investigating each of these aspects requires obtaining different information. Studying rail efficiency is also difficult because of the complexity of the conditions under which rail services are provided.

Accurate identification of the determinants of railway sector efficiency, taking into account its complexity, requires a very large dataset, not always available and quantifiable. The availability of data is the main problem. As ITF experts note in the report quoted in the article, research into the effectiveness of railways in the EU has been hampered by a lack of good quality data. Thompson and Bente, on the other hand, state that most railway undertakings do not see the need for detailed information for internal management purposes or consider that it is not in their interest to disclose such information in order to make public comparisons (Bente, Thompson, 2014).

However, due to the public subsidisation of railways, public authorities have the right to require undertakings to report key data. This would allow for a study of railways efficiency, at least in basic terms, and a comparative analysis of results, which could be a path to beneficial change. In view of the role of railways in a sustainable transport system, the criteria for assessing the efficiency of the sector should be extended to environmental and social effects, which have a substantial and quantifiable value.

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ARTICLES

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The conditions of development of innovative business undertakings at the time of the COVID-19 pandemic

Abstract

The paper is theoretical and analytical and aims to analyse and assess the impact of the COVID-19 pandemic on start-ups in Poland. Its first part discusses the specific nature of start-ups and the conditions of their development, known as the start-up ecosystem. The effect of these entities on economic development is addressed, too. The article then attempts to assess, based on domestic and international reports and analyses, the impact of the SARS-CoV-2 pandemic on start-ups in Poland and the prospects of their development.

JELL Clasification Codes*: M13, O31*

Key words*: start-ups, development, SARS-CoV2 pandemic*

Paper type*: Theoretical research article*

1. Introduction

The COVID-19 coronavirus pandemic began its active global spread in early 2020. The situation was particularly difficult in Italy, Spain, China, Iran, South Korea, and the United States. It developed very fast, bringing grave changes that affected various areas of society, state, and business as a consequence (Duda et al., 2021, p.140; Starostin *et al.,* 2020, p. 531). Start-ups are becoming particularly important parts of the knowledge-based

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economy and the stimulants of its international innovativeness and competitiveness. The COVID-19 pandemic has caused huge turbulences in the global markets. Enterprises face a number of restrictions, prohibitions and limitations that often prevent their activities. Tourist, entertainment and catering firms have suffered most painfully. In spite of the difficult socio-economic situation, the COVID-19 pandemic has not become a barrier, but an accelerator of development of Polish start-ups. "*For entrepreneurial ecosystems, 2021 is turning out to be a year of remarkable growth and productivity. And the dispersal of success—already underway before the pandemic—has only accelerated"* (GSER, 2020).

The purpose of this article is to analyse and assess the impact of the COVID-19 pandemic on start-ups in Poland. To this end, the following hypothesis is adopted: *The innovative nature and flexibility of start-ups enables most of them to adapt to the changing market conditions in effect of the SARS-CoV-2 coronavirus pandemic.*

In order to realise the objective and prove the hypothesis, data and information contained in the studies and reports of Polish and European institutions and organisations are analysed and the specialist literature is reviewed critically.

2. Innovative start-up undertakings – the conditions of development

The globalisation of contemporary economy and the very intensive development of information and communication technologies enhance the potential of even the smallest enterprises for expansion to the international market. As a result, businesses offering innovative tangible and intangible products in the virtual environments of the global market gain importance (Sieradzka, 2020, p. 251).

Start-ups are a specific group in the population of enterprises. These entities are capable of creating new markets and thereby contributing to the creation and satisfaction of needs and to the increase of employment and consumer spending (Kowalewski, 2020, p. 13). These firms escape the classic principles of management. The unique nature of start-ups and the relatively high risk of their operations cause only few to survive and expand their activities. Nine out of ten are said to fail (Patel, 2015).

Specialist literature offers a number of original definitions of the start-up that stress their temporary market operations and searching for scalable business models (Blank, Dorf, 2013, p. 50), the development of new products/ services in the conditions of uncertainty (Ries, 2011, p. 37, Kubiński et al., 2017, p. 117), the potential for quick growth owing to technological advantage or a market niche (Beaucham, et al. 2017, p. 9), young age, knowledge absorption, innovativeness of operations,

and the capacity for a dynamic growth of staffing and sales (ESM, 2016, Skala, Kruczkowska, 2016). A.Wilhelm states an enterprise to be treated as a start-up must meet the following conditions: below US$ 50m of annual revenue, not more than 100 employees, and value of below US$ 500m (Wilhelm, 2014). A start-up's spending is greater than revenue at the early stages, since its founders focus on the development and testing of ideas. The definitions of start-up commonly underline the issues of risk and uncertainty of business, therefore (Kowalewski, 2018, p. 247).

Based on a range of start-up definitions, some characteristics can be distinguished that make them different to other firms. Start-ups are said to be (Kaliszczak, Sieradzka, 2018, pp. 93-94):

- Innovative,
- In the early phases of growth,
- Learning,
- Operating in the conditions of extreme uncertainty,
- Looking for a profitable, reproducible, and scalable business model,
- Using some alternative sources of financing,
- Creating new technological solutions in the area of ICT,
- With a potential for a dynamic, above-average development and market expansion owing to a technological advantage or market niche.

Start-ups are described as innovative organisations since they operate in the field of high technologies and their (scalable) business model is founded on the processing of knowledge, data, and information. Most start-ups are unique organisations that escape the schematic, traditional development of enterprises. "They operate on the basis of a new business *paradigm of multi-level openness and attempts at creating effective business models*" (Chrzanowski, Zawada, 2018, p. 42).

The development of start-ups is to a large extent dependent on an efficient environment, both close and more distant. The environment of start-ups is referred to as the ecosystem. It is made up of all entities and organisations interested in the process of initiating innovation and transforming it into prosperous business undertakings (Kołakowski, Góral, 2017, p. 243). The key parts of the start-up system comprise (Debb, 2019): entrepreneurs, investors, mentors, universities, incubators, corporations, central and local administration, service providers, business accelerators, associations, and events. The key features of mature start-up systems encompass (Sagan, Wiśniewska, 2018, p. 14): reinvestment of profits, cohesion with the strengths of a given region, interregional cooperation, implementation of promotional actions, a system of ecosystem

development evaluation, a shared vision, and systematic and persevering work of stakeholders.

Global Start-up Ecosystem Ranking (2021) implies the best start-up systems function in North America (50% of 30 best ecosystems), followed by Asia (27%), and Europe (17%). The ranking assesses the following factors: performance, founding, connectedness, market reach, knowledge and talent, rated on a scale of 1-10. The five best developed ecosystems globally have not changed since 2017 – the Silicon Valley is the world leader, while London and New York City are equal seconds. Peking and Boston come in fourth and fifth. As far as 100 largest emerging ecosystems are concerned in regional terms, the ecosystems from Europe and North America prevail. Poland (Warsaw) doesn't make it to the global forty of the best start-up ecosystems in the world. Two factors, performance and market reach (3 and 2 points, respectively), gain particularly low evaluations.

The Polish start-up ecosystem is analysed by Deloitte (2016) to identify five key areas of support – financing, legal regulations, human and social capital, and institutional environment. By comparing the Polish ecosystem with a model of maturity, a relative assessment of Poland with reference to a group of countries is arrived at. Each of the factors is rated on a scale of 1-4, where 1 is the lowest and 4 the highest rating. Poland scores highest on legal regulations (2.55) and institutional environment (2.5). Social capital (1.5) and financing (1.68) are seen as the least developed. Human capital (2.27) is moderately developed.

Start-up communities are some major sources of innovations as well as impressive business revenues. The top 100 emerging ecosystems represent over $540 billion in ecosystem value, a 55 percent increase from last year (GSER, 2021). The dynamic development of start-ups contributes to national economic development through (Kowalewski 2020, p. 15):

- The impact on GNP and employment,
- The development of human and social capital,
- Raising household revenue,
- The improvement of living and working quality,
- Contributions to public finances,
- The external effects of innovations.

The largest start-ups in the world are global brands, estimated at billions of dollars and employing thousands. The latest ranking of unicorns, that is, start-ups valued at over $1 billion, identifies 936 unicorns with an estimated total value of $ 3,049B in 2021. The ranking is topped by Bytedance and SpaceX, with the values of $140B and $100B, respectively (CBISIGHTS, 2021). In 2021, the highest valued unicorn in Central and Eastern Europe is the Romanian UIPath ($35B), a producer of systems

automating office work (300gospodarka.pl). According to Delroom's "*Coming of age: Central and Eastern Europe*" (2021), there are eight firms with values above €1B in Poland, namely, InPost, CDproject, Huuge Games, DocPlanner, TenSquareGames, eObuwie, WirtualnaPolska, and Allegro.

More than 4,700 start-ups are estimated to operate in Poland in 2020, including 60% of IT and ICT enterprises (Duszczyk, 2020). By 2023, they are expected to generate (directly, indirectly, and by induction) a total of PLN 2.2B of added value (Deloitte, 2016). These enterprises are open to international trade. Nearly a half (48%) of the Polish start-ups are exporters. They record a majority (over 50%) of their revenue from operations abroad (Krzysztofik-Szopa, Wisłowska, 2019). Most start-ups are recent business undertakings that have been in the market for a short time (in 2021, 34% for up to 2 years) and have few workers – a third (32%) employed up to 10 people and a quarter up to 3 people. Those with staff of a dozen accounted for 15% of the group, while 16% have 21 to 50 workers (Dziewit, 2021). The start-ups in Poland, however, are estimated to generate more than 34,000 new jobs by 2023 (Deloitte, 2016).

The effect of start-ups on the job market is important from the viewpoint of the quality of human and social capitals, too. Jobs in a start-up require high qualifications in new, dynamically developing industries like: biotechnology, e-commerce, nanotechnology, or information technology. These specific positions require continuing learning and improvement of qualifications. Importantly, start-up teams are frequently international – 25% start-ups hire foreigners (Dziewit, 2021).

The external effects of innovations created by start-ups have a positive influence on the development of the national economy by affecting not only the sectors they are active in but also on the so-called related and supporting sectors.

3. The SARS CoV-2 coronavirus pandemic and the development of start-ups in Poland

The impact of the COVID-19 pandemic on socio-economic development is negative globally. Successive restrictions, lockdown, shrinking revenue, lay-offs, production downtimes, and bankruptcies are the problems faced by all businesses. The perceived effects of the pandemic on start-ups in Poland are polarised. 39% of the firms queried assess the impact of the pandemic on development opportunities as adverse, whereas 34% are of the opposite opinion, while every third start-up (27%) claims the pandemic has had no effect on their operations (Arwaj, 2020, p. 19). If the absence of adverse developments is positive in the face of the pandemic threats, this means positive effects on the start-ups in Poland can be noted (61% point to no impact or its positive effects). The following are listed among the positive factors: the acquisition of new

customers, growing sales, and retention of staff (key workers), indicated by 56%, 48%, and 43% of the start-up owners, respectively. Improved customer loyalty, more opportunities for entering new sales markets, and finding of new clients are seen as positive changes (Table 1). The influence of the pandemic on the development of start-ups is perceived differently by 39% of the entities surveyed, including 14% pointing to a very negative impact. More than a half of the start-ups (53%) identify the impossibility of acquiring new customers and declining market demand (35%) as the crucial threats to their development. More than a third mentioned the necessity of exiting or the limited possibilities of entering new sales markets. As a result of the pandemic, the customer loyalty has been undermined and valuable staff have been lost (Table 1).

Table 1. The impact of SARS-CoV-2 coronavirus pandemic on the operation of start-ups in Poland

POSITIVE IMPACT		**NEGATIVE IMPACT**	
No reduction of employment	43%	Reduction of employment	8%
Improved customer loyalty	11%	Impaired customer loyalty	16%
Entry in new sales markets	15%	Limited access to new sales markets	34%
Acquisition of new staff	18%	Limited sales of product/ service	35%
Higher sales of product/ service	48%	Limited opportunities for the acquisition of new customers	53%
Acquisition of new customers	56%		
NO IMPACT			
No reduction of employment		43%	
The realisation of entry strategies in new sales markets		41%	
The preservation of financial liquidity		31%	
The growing numbers of new clients are projected		31%	
Unchanged customer loyalty		29%	
An unchanged quantity of products/services sold		29%	

Source: The author's compilation based on: Arwaj A., et al., (2020), *Polskie startupy. Raport 2020. Covid Edition*, Startup Poland.

The firms that have experienced neither a negative nor a positive impact on their functioning and development plans constitute a major grouping (27%). This is most often shown with no necessity of firing key workers (43%), the realisation of an assumed entry strategy in new sales markets (41%), and the preservation of financial liquidity. The maintenance

of ustomer numbers and loyalty and an unchanged quantity of products/services sold are important as well (Table 1).

As far as the pandemic's effects on the particular sectors are concerned, those that take a natural advantage of a growing demand for their products or services are the greatest beneficiaries, including agrotech, e-commerce, cybersecurity, medtech, social media, and e-sport. Gaming firms record the most positive assessments (80%). The fintech sector has been stimulated to develop, too – 50% of the industry approve of the effects of the crisis. Difficulties and development restrictions are experienced by the lending sector, tourism, food deliveries, and transportation. The most adverse effects (60%) are identified by businesses offering HR and blockchain technology services, due possibly to discontinued actions and the freezing of funding for development and innovation.

Faced with the changing market situation, nearly a third (28%) of the entities examined have changed their business model, seeing it as an opportunity for rising revenue and improved customer relations. The following causes are indicated (Arwaj, 2020, p. 29):

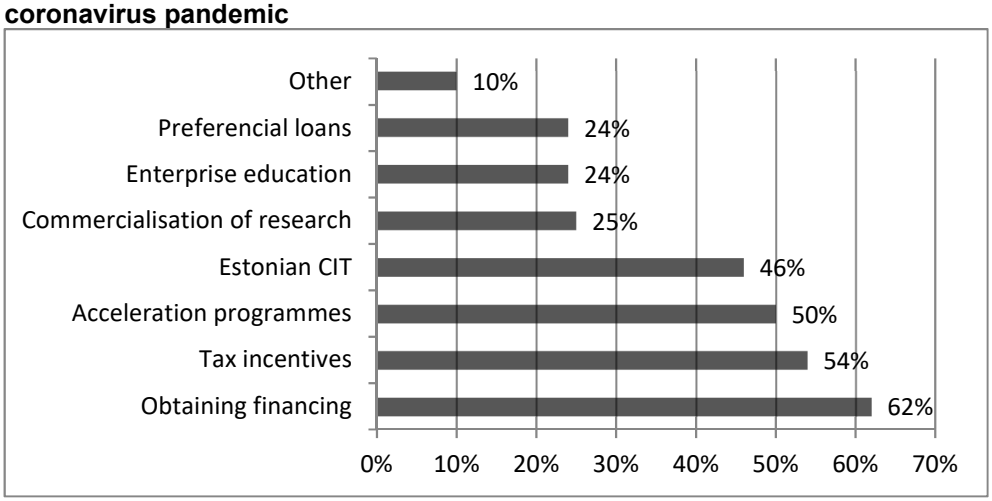
- Opportunities for more revenue are noted in another model (52%),
- A change of customer relations (43%),
- The necessity of changing distribution channels (33%),
- Lower revenue and attractiveness of the current business model (26%),
- Departure of partners (6%),
- Other (9%)

In connection with changes in the market, any new sources of financing are increasingly hard to find. Own funds continue to be the first source of capital for Polish start-ups. The resources obtained from the Polish Agency for Enterprise Development and domestic accelerators, VC funds and business angels are some major sources of capital. 3-5% start-ups use the support of foreign investors (business angels and VC funds). Entities utilising investor capital normally carry through a single round of financing (33%), with far fewer (8%) engaging in two rounds and a mere 3% engaging in three. The amount of financing commonly ranges within PLN 1-2m and 0.5-1m – this is true of 24% and 19% of firms acquiring external capital, respectively.

37% of the entities studied mention mounting problems with obtaining external capital. Moreover, half the start-ups examined expect more support of the state, chiefly as subsidies, tax incentives for investors, government acceleration programmes, and tax simplifications (Fig 1). As part of the latter, the need for the so-called Estonian CIT is cited to improve the competitiveness of domestic businesses by simplifying reporting

and realising more capital for investments (as CIT needn't be paid as long as profits remain in a company). In spite of the clear expectations, a majority of start-ups do not benefit from public aid. Scarcely a third resort to national insurance exemptions and loans as part of the so-called anti-crisis shields for small and medium-sized enterprises in Poland. Such a meagre percentage results, among others, from their inability to meet the key condition – demonstrating a loss of revenue (quarterly or year after year) – due to their short operation, an utter lack of revenue, or possibly an excellent standing that does not qualify them for the support.

Figure 1. Start-ups' expectations of public aid during the SARS-CoV-2 coronavirus pandemic



Source: The author's compilation based on: Arwaj A., et al., (2020), *Polskie startupy. Raport 2020. Covid Edition*, Startup Poland.

The continuing pandemic and subsequent restrictions raise the question, how will the coronavirus pandemic circumstances affect the future of start-ups? The distribution of responses is optimistic. There are roughly the same shares of positives and negatives, with the former slightly prevailing. 44% of those surveyed outline optimistic development prospects for their undertakings, with 7% seeing their business future in highly bright colours. 39% of the firms asked, on the other hand, declare an adverse impact of the pandemic on the operation of start-ups in future, including 5% offering very pessimistic forecasts.

4. Conclusions

The ability of an economy to innovate determines its competitiveness. At the company level, innovations can help develop efficiency, and in times of crisis (such as the COVID-19 pandemic), they can ensure continuity

or profitability. The countries of Central and Eastern Europe (including Poland) are essentially emerging innovators (EIS, 2021). One of the key issues when it comes to catching up in economic terms and modernisation in the region is the development of innovative capacity. Start-ups play an important role in this process: they can boost innovative potential significantly, mainly through the technological solutions and innovations they implement (Wisniewski, 2021, p. 3).

Start-ups, like other enterprises, contribute to economic growth. With their innovative nature, they make a creative contribution to the production process and launch new products/ services in the market. They influence employment and the quality of human and social capitals. A vital significance of the external effects of innovation to intermediate and supporting sectors is highlighted.

The development of start-ups is conditional on an efficient ecosystem comprising institutions, organisations, and entities supporting the process of initiating economic innovation. It is beyond any doubts that central, regional and local, public and private institutions should undertake any actions to improve the conditions fostering the development of start-up ecosystems.

The following conclusions can be offered based on this analysis:

- Start-ups are innovative business undertakings whose characteristics are different than those of classic firms;
- A dynamic development of start-ups can have a considerable impact on innovation of an economy and economic growth;
- The perceived effects of the pandemic on start-ups are not uniformly adverse;
- New clients and improved sales, combined with the lack of a necessity of redundancies are the measures of success of many a Polish start-up at the time of the pandemic;
- A great majority of the start-ups (75%) have not taken advantage of the so-called anti-crisis shields;
- Most start-ups expect more state assistance with, for instance, obtaining financing and simplified taxation.

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