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PREDICTABILITY OF TRANSPORT DEVELOPMENT

Abstract

This article is a generalization of the author's experience gathered when preparing transport development forecasts in Poland over the past quarter of a century. These forecasts have proved to be less accurate when prepared using only quantitative and strictly mathematical methods, and more accurate when the change indicators have been estimated using the expert (intuitive) method. The problem of inaccuracy of economic and transport forecasts can be explained by the notion of predictability, which makes it possible to divide phenomena into those that are more difficult or easier to predict and to identify phenomena that are not predictable at all. The existence of unpredictable phenomena has its source in influencing the reality of systemic determinants and random factors that have no bearing on the timeline. Predicting the need for transport requires the use of different methods for freight transport and different methods for the transport and mobility of people. The source of changes in the volume of the transport demand are predominantly fluctuations in the intensity of production and consumption, and changes in the need to cover space and, to a lesser extent, this source is the generation of new demand through the additional supply of services and transport capacity. Owing to the increasingly comprehensive statistics from past periods it is possible to establish that the correlation between the GDP and freight traffic is much weaker than previously thought. The demand for transport and mobility of people is less dependent on economic activity, and more dependent on demographic changes, the lifestyle of the population and the preferences in choosing the means of transport.

Keywords: predictability of phenomena, economic forecasts, transport needs, correlation between GDP and transport

Introduction

The concept of predictability exists in many languages (for example: *przewidywalność*, *prévisibilité*, *previsibilidad*, *prevedibilità*, *Vorhersagbarkeit*, *предсказуемость*) and it is closely related to the forecasting of future phenomena, events and ways of behaviour. Predictability is one of the basic concepts in human life, but it has not yet been well defined and described in encyclopaedias, lexicons, publications and scientific studies¹. The essence and manifestations of predictability of various phenomena can be studied using the few existing definitions that contain a roughly specific interpretation. According to the Cambridge Dictionary, predictability is a feature of phenomena that happen in a way or at a time that is known before it happens (Predictable, 2017). According to *Power with Words*, predictability is a state of mind, pattern of behaviour, or course of action that makes it possible to know in advance what to expect (Predictability, 2017). It is worth quoting a statement published in a blog that the predictability of a system means the accuracy with which future states of this system can be predicted based on our knowledge of the initial state (Chaos, 2017). However, this general feature covers the unpredictability of specific systems both of a natural and economic-social nature.

The purpose of this article is to provide a methodological basis for the correct estimation of economic development based on the experience gained during the forecasting of the development of transport – one of the most turbulent sectors of the economy in the past years. An important condition for correct prediction is the awareness of the existence of predictable and unpredictable phenomena, which can be achieved by careful analysis of the nature and dynamics of natural and economic phenomena. The inaccuracy of the economic forecasts developed in the past was due to both the weaknesses of the forecasting methods and the neglect of the unforeseeable phenomena. Attempts to predict unforeseeable phenomena, even with sophisticated mathematical methods and with rich historical information, are doomed to fail. Unpredictable phenomena should be included in the set of economic risk factors rather than trying to create a rule for their appearance.

Contrary to appearances, it is not easy to generalize the reasons for the failure of economic forecasting because authors of inaccurate forecasts refrain from publishing analyses of the causes of their forecast failures and sufficiently empirical material is lacking. A review of paper and web publications proves that the references of the causes of inaccuracies in forecasting are surprisingly poor. Nevertheless, there are many programs and studies suggesting the possibility of accurate economic forecasting using advanced models and rich databases. This article is a warning against over-confidence in these models and their results.

On the basis of long-term observations and empirical analyses, it is possible to create a limited set of predictability rules that should be the basis for short- and long-term forecasts. The rules of predictability are reliable when a chain

¹ The predictability studies available in the Internet include considerations concerning its nature in selected areas of natural, social, military or formal reality, nevertheless, it is difficult to generalize them and formulate universal rules. Cf. e.g. Feder, Merhav, Gutman, 1992; Kelly, Kilcullen, 2004; Blattner, Catenaro, Ehrmann, Strauch, Turunen, 2008; Stevenson, Moldoveanu, 1995.

of events over time is governed by the laws of causality, especially by determinism. Both quantitative and qualitative predictions of phenomena allow creating approximate scenarios of future development, if the authors of forecasts have strong evidence that the analysed phenomena are characterized by a sufficiently high predictability as to their general nature and specific symptoms.

Predictability decreases exponentially with prolongation of the forecast horizon and decreases also exponentially with an increase in the detail of the features of the predicted phenomena. In a rationally defined time horizon the range of probable trends is predictable, while the strictly quantified future phenomena at particular moments on the time axis of the forecasting period are unpredictable. It is possible to predict the future state of continuous processes that are known to be unable to stop or change the direction and whose intensity is known from the past. However, random and chaotic single events that are not elements of continuous processes are unpredictable. We know from practice that the moments of coming of a storm front, an earthquake or an economic crisis are unpredictable. The awareness of predictable and unpredictable phenomena is the basis for the development of realistic forecasts.

1. Predictability of economic phenomena

Predictability is a desirable feature of all spheres and types of economic activity which is hard to achieve. Not everything in the economic life is as organized as would be desired by logicians and mathematicians. Unlike in the nature, in economic systems the course of the same processes based on the same factors is not repetitive and identical in time. There are random factors and factors related to the human free will that are hard to classify in the rules and models proposed by logic. What happens in the economy is to some extent determined by the logic of nature and technology, however, there is a seemingly chaotic set of human behaviours which determines both the craft of the manufacture of goods and provision of services as well as the sense of their consumption. The chaos and spontaneity in the ways of human behaviour are not inevitable, and these negative attributes could be reduced by forcing human masses to more rational behaviour. The predictability of economic activity is in fact very limited as a result of the impact of a plot of various objective and subjective factors. The objective factors eliminating or reducing the predictability of economic processes are: the complexity of systems and their low communication efficiency, the random (chaotic) nature of elementary events, the spontaneous interaction of the forces of nature on economic structures and processes, the variability of the needs and tastes of people.

Everyone would like to know fairly accurately the future state of the financial markets, exchange rates, price levels, investment efficiency and other basic economic parameters, but the objective nature of business systems and business risk has to be accepted. The predictability of economic events can be increased primarily by continuous accumulation, systematization and analysis of reliable information on the course of economic processes. The aware interference of man with

the economic reality does not always contribute to increasing the ability to predict. The practical experience shows that predictability is decreased by such subjective factors as the instability of political, legal, fiscal systems and degradation of social attitudes.

Passive waiting for what the fate will bring is not a rational economic attitude. It is necessary to anticipate future events and adapt to their effects. In economic life, it is possible to predict some inevitable events (both positive and negative), and one should become prepared for the occurrence of unforeseen random events. Immediate or very likely are events included in the mechanism of continuous economic processes such as: generation of subsequent series of products, gaining new revenues from sales on the market, consumption and renewal of the means of production, depletion of natural resources, etc. On the other hand, such economic events as extraordinary good or poor harvest, the opening of new large markets or introduction of trade embargoes, the discovery of new natural resources, effective implementation of breakthrough product or process innovations, etc.

Future events are guessed using more mature and better proven methods. Old divinations and conclusions from the intuitive behavioural observations of animals and birds have been almost completely replaced by regular statistical observations, mathematical models, and experiments conducted using special simulation devices. Nevertheless, the economic predictability cannot be reduced to guaranteeing attainment of the intended objectives. Absolute economic predictability could exist only in cases that are governed by determinism similar to classical mechanics. In practice, there are no such cases since the economic life is governed by laws of a stochastic and not deterministic nature (Guru, 2017).

2. Predictability of processes in transport

Phenomena and economic processes in transport can be divided into two main groups: a) services offered to users (transport operations, transshipments, transport organization, logistics), b) activities related to the enlargement and modernization of the transport and logistics sector's production potential. Both groups exhibit high volatility during the intensity of various types of processes and activities. Transport is characterized by very low self-sufficiency and low economic autonomy, both in terms of acquiring new resources and development factors, and in shaping the size and structure of production (offering services). This is a sector highly dependent on external (physical and financial) supply and it is very much dependent on the whims of the external demand for the services offered. The forecasting of transport processes based on mechanisms operating within this sector is therefore limited and must be made with great caution. The authorities of ports and airports as well as carriers cannot be too optimistic about forecasting their growth simply because they have large reserves of the production potential. The hopes for the transport volume growth are often undermined by the economic, social and political forces that are active outside the transport sector (as evidenced by factors such as new environmental standards and stricter security rules, the policy of preferring

certain modes of transport, minimum wage regulations, control of anti-dumping practices, etc.).

The intensity of transport operations is determined by internal and external factors. The internal factors are related to the mechanisms of the functioning of transport systems including the behaviour of carriers, competition in transport markets, changes in the infrastructure capacity, changes in the capacity of the means of transport, changes in the organization and technology of transport, changes in the traffic intensity in the transport network. These factors are most often conducive to the stabilization or moderate growth of transport operations, except for a situation when transport workers strike and when there is severe weather disturbance resulting in limitations of this activity. On the other hand, external factors are related to the sources of transport needs, the economic situation, the needs and behaviour of transport users, the decisions of transport markets regulators, the status of international relations relevant to transport operations.

Transport phenomena as a division of the economy are more difficult to predict than the main indicators of the state's economic system. Freight transport processes are subservient to manufacturing and consumer systems, and even a controversial derived transport demand thesis has been formulated (Rodrigue, 2006). The predictability of freight transport processes is determined to a great extent by ways in which transport needs arise (spatial distribution, cooperation and specialization of production, intensity of international exchange, logistic supply chain management, etc.). If the level of predictability of the growth of industrial, construction or agricultural production is low, the predictability of the growth of the demand for transport of goods needed for the functioning of these sectors is low as well. Moreover, the volume of demand for transport is influenced by the market factors and the transport policy regulatory instruments the predictability of which depends on the political, legal and social stability of a given country. Nonetheless, there are certain spheres of material production which generate fairly stable demand for freight transport in all socio-political conditions, including the fuel and power economy, manufacture of basic food products and waste management. In these spheres the demand for transport can be predicted on the basis of annual growth in past periods. On the other hand, it is hard to predict the demand for freight transport strongly determined by the economic situation, including the volume of transport serving the international exchange (exports and imports), the land and sea transit, cross-trade transport.

The predictability of processes in passenger transport varies greatly depending on the considered type of passenger transport. According to the OECD classification, passenger transport is divided into four types: a) Commuting to Work and Education; b) Business; c) Holidays, Vacation; d) travels related to everyday life – Shopping, Leisure, Family (OECD, 2007). Each of these types of passenger transport has a specific tendency to change. The predictability of the demand for commuting to work and schools is relatively high, as these are continuous, repetitive processes contained in rigorous time limits which are disrupted by random or economic factors to a limited extent. The most difficult to predict is the demand for leisure and tourism travel, as it is less irregular and more susceptible to various dynamic economic and social factors.

Empirical observations indicate that the predictability of the transport capacity development is greater than the predictability of transport markets. The statistics show that in practice economic cycles do not lead to reductions in the length of the transport infrastructure network and they do not even significantly reduce the number and the payload of the vehicles. If there is a stable funding system for investments, there are also good reasons to forecast accurately over a given time horizon, how the planned capacity of the transport system will increase (how many kilometres of roads will be built, how much the capacity of ports and airports will increase, etc.). Mostly, the development and upgrading projects (especially in the transport infrastructure) are carried out with some delay in relation to transport activities. However, the effects of such projects are quite predictable, they can be carefully planned and implemented on time as long as it is possible to effectively manage the involved risks (Borkowski, 2013). The investment process is most often carried out without any significant braking, even if there are signs of a reduction in the demand for its effects.

Nonetheless, the possibility of accurately predicting changes in the demand for transport services on the market is much smaller. The possibilities of predicting changes in the demand for domestic transport services are relatively greater than for international transport services, especially in the area of cross-trade, cabotage and transit operations. Nevertheless, even in the field of domestic transport, the predictability is limited by the poor correlation between the GDP growth and the growth of this transport.

In practice, there is no close correlation between transport (market) activity and the development processes in transport. As a rule, the development and modernization processes are carried out with some delay in relation to the increase in the transport volume. It is rarely that they are carried out some time ahead of the expected economic development. Nor is there any symmetry in the growth of transport and development activities due to changes in the economic situation. Any decrease in the demand forces carriers to reduce their transport offers, as transport services cannot be stockpiled. Each increase in the demand for transport requires the use of additional transport production factors, as it is not possible to reach for a service that cannot be stored.

3. Mathematical illusions of increasing predictability

In Future transport processes can be predicted by various methods, depending on the nature of these processes and the dynamics of their change in past period. If these processes are characterized by continuity, a steady direction of changes (upward or downward) and fairly stable dynamics of annual changes (small amplitude of fluctuations) – it is possible to predict them fairly accurately using extrapolation methods. Nevertheless, such an idealistic kind of trends in business and transport is very rare. Economic indicators are most often characterized by a very high fluctuation of changes both at annual, quarterly or monthly intervals. Nonetheless, the extrapolation of the current trends, even those of a most stable

nature, gives a reliable result only in a limited time horizon (Brezinski et al., 2013). Predictions even for the next year or a quarter of the year using the extrapolation technique are unreliable, and what to say about the prospect of a dozen or several dozen decades.

Empirical observations prove that changes in the economic situation cannot be predicted even for the nearest quarter. Attempts to apply mathematical methods of predicting economic and transport processes in a refined way are an illusion. This can be justified by an example of the difficulties in creating a mathematical function accurately reproducing the fluctuations in the road transport performance volumes in the EU-28 in the period 2004–2015. If we assume that the volumes for the following year were not known in particular years during this period and if these volumes are calculated using the extrapolation technique of the change recorded in the preceding year, then the comparison of the results of such a forecast with the actual values will make us realize how wrong we can be believing this method (Figure 1). For example, extrapolating the declining trend recorded in 2009 to 2010 we will receive the volume of 1528 billion tkm, while in reality it was the volume of 1756 billion tkm that was recorded in the statistics of 2010. The greatest weakness in the extrapolation method is the assumption that the trend in the next forecast period will be the same or very similar as in the earlier period. This method is “resistant” to seeing strong turnovers in trends that can be included in the forecasting model based on expert qualitative assessments and the identification of the occurrence of turning points.

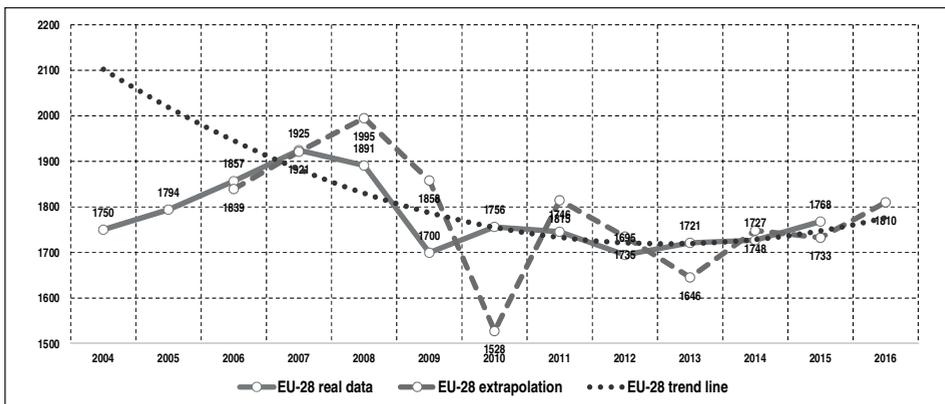


Figure 1. Accuracy of extrapolation forecasting of road freight traffic in the EU 28 in 2004–2015
 Source: (own study based on Transport Statistical Pocketbook, 2004–2017)

In practice, extrapolation methods provide satisfactory predictability in the above-mentioned types of economic and transport activities that are characterized by small fluctuations in the dynamics of development. The fluctuations in transport performance volumes in freight transport are in practice very large and it is difficult to describe them using mathematical functions reflecting the specificity of fluctuations in these specific processes (non-repeatable cycles). It is therefore necessary to apply methods to capture the impact of the most important external

variables. The most popular external factor determining the demand for freight transport in forecasts is the GDP growth. In some studies and publications, it is possible to find even hypotheses about a high correlation between the GDP growth and the growth in the demand for freight transport (Bernacki, 2010). In some countries statistics show that there is indeed a strong correlation between the GDP growth and the growth in the demand for freight transport (for example in Poland or Germany). However, a detailed analysis of macroeconomic and transport data in the European Union for the period 2004–2015 leads to quite surprising conclusions with little correlation between the two forms of economic activity. It turns out that the average correlation in the EU-28 between the GDP and the land transport performance (road, rail, inland waterway and pipeline transport in total) in this period was minus 0.17, and the correlation between the GDP and the international land transport performance (export, imports, cabotage and cross-trade) was plus 0.47. These empirically established indicators are inversely related to hypothetical expectations and appear illogical, nonetheless these are statistical facts.

The explanation of the lack of correlation between the GDP growth and the growth of the demand for domestic land freight transport in the European Union are the structural and technological changes in the economy. In many countries, the GDP is predominantly created by the service sectors of the economy, which do not generate any significant demand for freight transport. In countries with a high role of services in the economy (73.1% in the UK, 70.5% in France, 70.1% in the Netherlands), a low correlation between the GDP growth and the growth in the demand for freight transport is observed. The correlation coefficients in the EU-28 for the period 2004–2015 are illustrated in Figure 2.

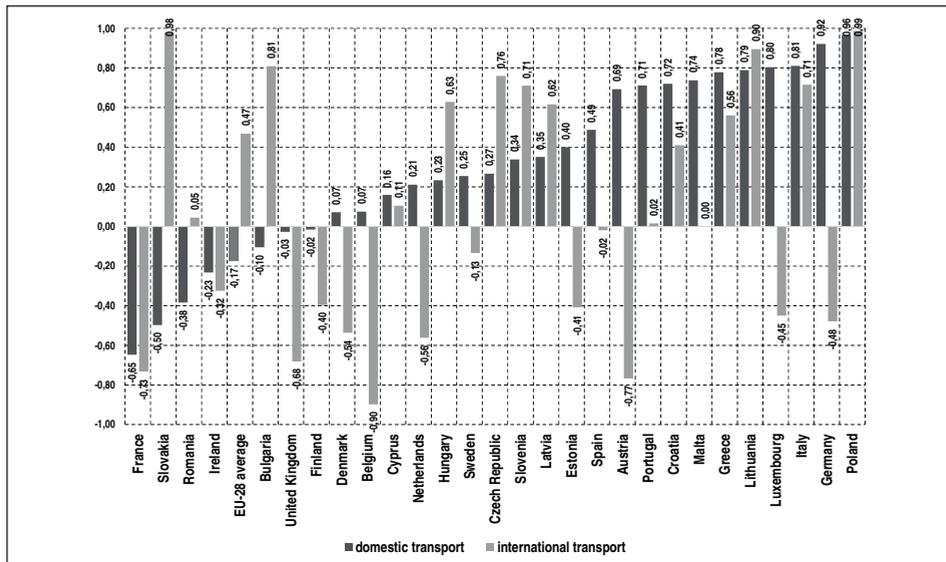


Figure 2. Correlation between GDP growth and land freight transport performance (tkm) in EU-28 in 2004–2015

Source: (own study based on Transport Statistical Pocketbook, 2004–2017)

Hence, the overall economic activity of a country is not a factor sufficient to forecast the demand for freight transport. It is necessary to consider other factors influencing this demand, such as: changes in the structure of the economy and in the structure of the production of material goods, reduction in material consumption and energy intensity of production (Prester et al., 2016), changes in the location of production, etc.

In passenger transport, the predictability of demand for transport is facilitated by persistent upward and downward trends or stagnation of demand observed in the past period. Some tendencies are well-grounded in demographic changes, lifestyles of residents, preferences for the means of transport. In the last two decades it has been possible to observe steady trends in the demand growth of more than 2% per year for air travel and automobile transport in the European Union, in all Member States². Hence, in the prospect of the next 10–15 years, the demand for these two types of passenger mobility is predictable, the forecasts may be upward in nature, nonetheless such growth cannot last indefinitely. An opposite trend was seen in the period 1990–2015 with regard to long-distance coach services, where the demand in the EU-28 fell regularly by 0.2% per annum on average (decreasing in 16 Member States, and slightly increasing or stagnating in 12 other countries) (Transport Statistical Pocketbook, 2004–2017). This downward trend cannot last too long, as this would be a contradiction to the sense of long-distance coach transport.

The most difficult to predict are transport processes that do not have a history as yet and which are born as innovations. In urban agglomerations with no underground transports, the forecasts for the municipal transport development generally did not include a vision of the development of transport by this means of transport. Such forecasts were made only after the first underground line was started.

In the European Union's common transport policy, it is assumed (White Paper, 2011) that the number of automobiles with conventional propulsion will be reduced by 2030 and that such automobiles will be completely eliminated from cities by 2050. These intentions should be accompanied by realistic forecasts of the growth of demand for urban travel by electric and hybrid automobiles. These forecasts are much more difficult to prepare than forecasts of the demand for automobiles with internal combustion engines. The magnitude of demand for electromobility (Sandén, 2014) is not a simple derivative of the purchase price and operating costs of a new generation of automobiles. As in the case of the demand for other types of services and means of transport, the demand for electric automobiles depends on many other factors where the organization of the process of withdrawing conventional cars and the functionality of electric automobiles in winter periods are of significant importance.

² An analysis of these trends is hindered by the lack or estimate nature of the transport performance volume in aviation and individual motor vehicles.

Conclusions

Understanding the issue of predictability of economic and transport processes is important for the correct preparation and use of forecasts. Forecasters are expected to provide forecasts that will be both detailed and valid for a given time horizon. In practice, forecasts rarely come true, especially when trying to describe the future in a very detailed way. Forecasts are an attempt to create an image of reality that does not exist yet, and the way of its creation is determined by mechanisms without any obvious scenarios. Forecasting is something completely different than exploring unknown lands. However, in the present state of reality, it is necessary to identify factors that determine possible development trends.

The predictability of transport processes is mostly determined by the fact that they are ancillary to other economic and social phenomena. The dynamics of these processes is mainly due to the changeability and variability of the needs of transport users and, to a lesser extent, to the mechanisms of transport systems. Nonetheless, the impulses creating the new demand for transport arising from the enlargement and upgrading of the transport potential should be noticed. It is possible to identify such transport needs that are clearly formed as a derivative of a given sphere of the socio-economic life and there are such transport needs that are created (induced) by the pressure of the supply side of transport (offers of low fare airlines, launching of high-speed trains, attractive door-to-door transport services, etc.).

The volume of demand for transport is often characterized by fluctuations resulting from economic cycles, the implementation of new legislation, restrictions and standards, the occurrence of harmful natural phenomena (volcanic eruptions, floods) and social protests (strikes, blockades and transport points and networks). In forecasts of future transport phenomena and processes it would not be realistic and reliable to indicate that such phenomena will occur at certain times and that this will lead to specific changes in transport needs. A reliable forecast should be a set of smoothed series of numbers showing a range of probable development scenarios within a range of probable minimum and maximum quantities.

It has become common to forecast the demand for transport of goods in connection with the growth of major macroeconomic indicators, especially the GDP. It is done in this way with the presumption that there is a sustainable proportion between the intensity of physical production and exchange and the intensity of the demand for transport. Nonetheless, it is worth confronting this presumption with the statistical data of past periods. Such data shows that in many cases the correlation between macroeconomic and transport quantities is very weak or even negative. The magnitude of the demand for transport is influenced not only by the level of physical production and exchange, but also by changes in business location, optimization of transport and logistics processes, changes in the technology and organization of production, inventory management and other quantitative and qualitative factors.

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