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# Evaluation of location's attractiveness for business growth in smart development

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## ABSTRACT

The issue of a location's attractiveness for business development in literature lacks approach, when attractiveness is assessed not as a set of factors which determine individual attractiveness, but as a locality's ability to attract, maintain, and create business and investments. The contribution of the research to the discipline is a multi-criterion model of factors determining the location's attractiveness for business development in the context of smart growth, as a methodological tool to evaluate and analyse the scientific problem in a question which is proposed by us. The attractiveness of a location for business development in the model is combined with the concept of smart development. A new and reliable instrument for decision-makers and managers is presented. An example of panel data analysis of 36 indicators and 3600 observations from 10 cross-sections of annual data for determining the role of quantitative indicators in attractiveness index is provided and timing lags influence is assessed. The method proposed is suitable for the attractiveness analysis of any location if the necessary data is available.

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Location attractiveness;  
smart development;  
location theory;  
multi-criterion

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## 1. Introduction

The modern business conditions, a rapidly changing environment and consumer needs, globalisation, technical progress, new standards and peoples' attitudes force entrepreneurs, self-employed people and investors to analyse and evaluate the existing locations for business development and search for new ones, and rethink the existing and new strategies for selecting one option or another.

When choosing new locations for business development, a particular importance is attached to the business and investment environment, i.e., conditions, factors and circumstances which, as a set, are formed in the corresponding area and attract, sustain or encourage creating new business and investments. It should be emphasised that the attractiveness of the area for business development is shaped by the authority of

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the location, the location itself (through its geographical, natural, infrastructural, technological, demographic, socio-economic, cultural environment, etc.) and the entities of the economy that operate in that particular area. In most cases, local authorities become key developers, creators and advertisers of the location (as an attractive place to develop a business). However, entrepreneurs, self-employed people and investors are information collectors, analysts and decision makers; therefore, from many locations they choose the one that offers competitive advantages over competitors both in the long run and the short run. Thus, there is a close connection between the location's attractiveness for business development and the location of investment. For these reasons, the factors of a location's attractiveness for business development become main strategic guidelines in the process of a location's economic policy formation.

A number of fundamental works in the scientific literature are devoted to research of the problem of attractiveness. Most scholars analyse the concept of attractiveness through aspects of foreign direct investments (Lessmann 2013; Lukoseviciute & Martinkute-Kauliene, 2016; Markusen, 2013; Forte & Moura, 2013; Naraškevičiūtė & Barkauskaitė, 2014; Saez & Perianez, 2015) and the improvement of the business environment (Bruneckienė, Zykiene & Stankevičius, 2016; Ezmale, 2016; Litavniece, 2014; Miot, 2015; Zdrzil, 2015). It should be noted that the scientists who study this problem have focused primarily on the purification of the concept of attractiveness (separating both the investment and business development) as well as specification and the determination of characterisations (Gaule & Sinkiene, 2012; Servillo, Atkinson & Russo, 2012; Snieska & Zykiene, 2014, Snieska & Zykiene, 2015), the identification and analysis of deciding factors when it comes to attractiveness (Ambroziak, 2014; Arauzo-Carod, Liviano-Solis & Manjon-Antolin, 2009; Crozet, Mayer & Mucchielli, 2004; Ezmale, 2016; Godlewska-Majkowska, 2013; Litavniece, 2014; Nikolova & Plotnikova, 2013; Saez & Perianez, 2015; Snieska & Zykiene, 2015; Strzelczyk, 2015), or the more thorough analysis of their individual factors and the determination of the impact on the overall attractiveness (Gaule & Sinkiene, 2012; Glebova, Galiakhmetov & Yurkov, 2016; Kuliaviene & Solnyskiniene, 2014; Moraru, 2013; Naraškevičiūtė & Barkauskaitė, 2014), the development of attractiveness strategies and the shaping of the measures (Bruneckienė et al., 2016; Godlewska-Majkowska & Komor, 2017; Sinkiene & Kromalcas, 2010), on the presentation of investment and business opportunities in foreign and national markets (Bose, Roy & Tiwari, 2016; Chen, Chiang & Storey, 2012; Kim & Perdue, 2011; Lee, Hong & Makino, 2016; Lemaire & Viassone, 2015; Lin et al., 2016; Vanolo, 2015; Zenker & Erfgen, 2014). The analysis of a methodological basis for assessing the attractiveness in works of scientists (De Noni, Orsi, & Zanderighi, 2014; Glebova, Khamidullina, & Anisimova, 2015; Godlewska-Majkowska & Komor, 2017; Murillo, Romani & Surinach, 2015; Spalanzani, Ageron & Zouaghi, 2016) has received attention fairly recently. However, a more detailed analysis of the problem on a sub-national level, i.e., the location aspect, is missing. A rapidly changing business environment, changing society and their requirements for the company, entrepreneurs and investors condition a new approach to the attractiveness of the location for business development. The attitude towards the attractiveness of the location for business

development, expressed by standard factors and indicators, is already not enough to represent this concept and attract the attention of the target group, since many locations are assessed using the same or similar factors of its attractiveness for business development, which thus do not create a competitive exclusion for locations, and they become similar in respect of attractiveness. The latest scientific literature (Jucevičius & Kinduris, 2016; Jucevičius & Liugailaitė-Radzvickienė, 2016; Patašienė & Patašius, 2016; Ramadani, Zendeli, Gerguri-Rashiti, & Dana, 2018; Sinkienė, 2016; Stanislovaitienė, Gaulė, & Šiugždinienė, 2016) emphasises, that today the competitive advantage is created using not static, but dynamic capacities – insights, knowledge and innovation, learning, networking and collaboration, etc. They show an ability to achieve new and innovative forms of development or competitive advantage, therefore a new approach must be taken both in the concept of a location's attractiveness for business development, and strategies that will increase the location's attractiveness for such development.

However, against the current background, a new dynamic approach answering the challenges of the changing environment is missing in the research of location attractiveness for business development. It is important to consider the concept of this attractiveness in the context of smart development which reflects, characterises and corresponds to modern economic development tendencies, globalisation processes and strategies and trends of contemporary business development, and build strategies for increasing the location's attractiveness through components of development, new attitudes and new ideas. No researchers have employed an integrated approach towards the perception and evaluation of a location's attractiveness for business development. The issues of location attractiveness have not been researched in the context of smart growth seen as a new medium (conditions) where locations compete for investment, new jobs, human resources, technologies, knowledge and other factors. Despite the increasing interest in the topic of a location's attractiveness for business development, the scientific literature does not discuss the theoretically and empirically justified methodology for evaluating a location's attractiveness in the context of smart development.

**The purpose of the research:** to find the definition of location's attractiveness for business growth in smart development and generate a factor model, allowing calculating the index of the location's attractiveness for business growth in smart development according to the array of factors and their indicators.

The research methods: systematic, comparative and logical analysis of the scientific literature based on the methods of comparison, classification, systematisation and generalisation; multifaceted evaluation methods, and panel data analysis.

The paper is organised as follows. [Section 2](#) covers the literature review and analysis of location's, attractiveness, and smart development concepts. In [section 3](#) we present the methodological principles for evaluating the location's attractiveness for business development in the context of smart growth and a model of factors determining the location's attractiveness for business development in the context of smart growth. In [section 4](#) we present an example of panel data analysis aimed at statistical evaluation of the significance of the selected factors.

The contribution of the research to economic discipline is in the creation of the theoretically and empirically justified methodology for evaluating a location's

attractiveness for business development in the context of smart development. The research has important implications for decision-makers and managers.

## 2. The level of investigation of the research problem

It should be emphasised that the concept of attractiveness in the scientific literature has been analysed on/at different levels: on the level of company, branch of economy, city, region and country. The attractiveness of a location in regard to business development is usually analysed in two different aspects: from the perspective of the company, when the optimal solution, related to the selection process of the location eligible for the development of an activity, is assessed (Dubé, Brunelle & Legros, 2016; Frenkel, 2012; Giner, Santa-María, & Fuster 2017; Goerzen, Asmussen, & Nielsen, 2013; Kimelberg & Nicoll, 2012; Kronenberg, 2013; Mota & Brandao, 2013; Ramadani, Zendeli, Gerguri-Rashiti, & Dana, 2018; Spalanzani et al., 2016), and globally, when analysing the attractiveness of specific locations for businesses by simply highlighting the factors that are attractive (Ambroziak, 2014; Arauzo-Carod et al., 2009; Bruneckienė et al., 2016; Crozet et al., 2004; Ezmale, 2016; Godlewska-Majkowska, 2013; Litavniece, 2014; Saez & Perianez, 2015; Strzelczyk, 2015). Academic works which analyse the cases of company decisions to act in a certain location stress the importance of market orientation, consumer behaviour and influencing factors (Schmidt, Touray, & Hansen, 2017). However, these studies lack the attitude towards the attractiveness of a location as an ability to attract, create and sustain business and investments, because attractiveness itself is a dynamic process, and therefore the analysis of attractiveness, too, must be based on a dynamic attitude. Today, when competitive advantages are created both by static and dynamic factors, it is not enough to identify only the individual factors that determine attractiveness. A new approach to the concept of attractiveness is needed, based on the dynamic capacity of the location, which would allow forming the location's ability to be attractive. In addition, the concept of attractiveness in the scientific literature is mainly analysed from two different entities – from the perspectives of authority, companies and investors. Public authorities are most often analysed (Bruneckienė et al., 2016; Cohen, 2000; Gilmore, O'Donnell, Carson, & Cummins, 2003; Glebova et al., 2015; Kinda, 2013; Ling, 2011; Stanislovaitienė et al., 2016) as responsible for the creation and formation of the factors of attractiveness of the location, implementation of strategies, while companies and investors (Alama-Sabater, Artal-Tur, & Navarro-Azorin, 2011; Artal-Tur, Navarro-Azorin, Alama-Sabater, & Briones-Penalver, 2013; Bruneckienė et al., 2016; Dubé, Brunelle & Legros, 2016; Kimelberg & Nicoll, 2012; Mota & Brandao, 2013) are analysed as users of a location's attractiveness (they either choose that location or not). However, the analysis of the concept of attractiveness, from the dynamic point of view, does not allow these two views that are dominant in the scientific literature to be analysed separately, because local authorities, economic entity and the local environment itself and conditions create and form the overall attractiveness of the location. Thus, what is important is a complex understanding and assessment of a location's attractiveness for business development, which combines the interests of a businessperson and an investor, who seeks for favourable

conditions for business development, and local authorities, who seek to ensure the socio-economic development and competitiveness of a particular location, the location itself and the conditions.

In scientific literature (Bruneckienė, 2014; Bruneckiene & Lopez Ventura, 2015; Caragliu, Del Bo, & Nijkamp, 2011; Damurski, 2016; Juceviciene & Jucevicius, 2014; Jucevicius & Liugailaite-Radzvickiene, 2014; Jucevičius & Liugailaitė-Radzvickienė, 2016; Komninos 2006, 2008, 2011; Laberge, 2011; Sinkienė, 2016), the concept of intelligence has been examined in regard to different entities in the economic system, for example, government, economy, community, infrastructure. Ramadani et al. (2018) stress the capability to apply geomarketing in decision making when choosing a certain location for business establishment especially for location-based services. However, the concept of attractiveness has not been analysed in the context of smart development. In other studies (Alawadhi et al., 2012; Allwinkle & Cruickshank, 2011; Anttiroiko, 2013; Bakici, Almirall & Wareham, 2013; Nam & Pardo, 2011; Laberge, 2011; Sinkienė, 2016; Sinkiene, Grumadaite & Liugailaite-Radzvickiene, 2014; Weber & Chapman, 2011) a smart country, region, and city were analysed, distinguishing their specific criteria of intelligence. Scholars (Jucevičius & Kinduris, 2016; Jucevičius & Liugailaitė-Radzvickienė, 2016; Patašienė & Patašius, 2016; Sinkienė, 2016; Stanislovaitienė et al., 2016) looked at the smart social system through the prism of dynamic capacities, which formed the methodological basis for analysing a particular economic phenomenon in the context of dynamically smart development.

The concept of attractiveness is one of the research areas which is the most difficult to define and synthesise. It is related to different sections, levels, subjects of problem analysis, the specifics of locations, the multiplicity of the concept of attractiveness itself and the abundance and diversity of factors that determine such attractiveness. Different aspects highlighted by the scientists' analysis of the concept of attractiveness cause the emergence of different models that structurally connect factors affecting the overall attractiveness into one entity. Models that are found in the scientific literature the most often (Global Attractiveness Index, A Global Foreign Direct Investment Country Attractiveness Index, A. T. Kearne Global Services Location Index<sup>TM</sup>, Global Opportunity Index) focus on the analysis of national attractiveness of companies and different industries, and not the attractiveness of a certain location. The limited adaptability of these models in assessing a location's attractiveness for business development grounded the necessity of the creation of the factor model, oriented for the evaluation of the location's attractiveness for business development in the context of smart development (*LAB*). The lack of the concept in regard to the attractiveness of a publicly recognised location for business development in the context of smart development is illustrated by the abundance and diversity of factors (Ambroziak, 2014; Arauzo-Carod et al., 2009; Bruneckienė et al., 2016; Crozet et al., 2004; Ezmale, 2016; Godlewska-Majkowska, 2013; Litavniece, 2014; Saez & Perianez, 2015; Strzelczyk, 2015) identified in the scientific literature, that decide the attractiveness of the location. Although each location is distinguished by its specifics and environment, what are lacking in scientific literature are the main factors that determine the location's attractiveness for business development that are structured and

connected into one system by connections. The absence of the model revealing factors of location's attractiveness for business development in the context of smart development (*LAB*) makes the attractiveness assessment process, the making and implementation of right decisions in order to increase the attractiveness of the location as well as the achievement of the economic strategic objectives set by the location, more complicated.

In the scientific literature, the concept of attractiveness is evaluated using different methods. Some scientists (Godlewska-Majkowska, 2013; Kosinova, Tolstel & Chekalkina, 2014; Nikolova & Plotnikova, 2013; Yatsenko, 2016) evaluate the attractiveness on the basis of separate statistical macroeconomic indicators and their dynamics, the others (Dubé et al., 2016; Frenkel, 2012; Giner et al., 2017; Kimelberg & Nicoll, 2012; Kronenberg, 2013; Mota & Brandao, 2013; Spalanzani et al., 2016) identify it according to the financial indicators of companies. The third group (De Noni et al., 2014; Glebova et al., 2015) analyse good examples. In scientific literature the attractiveness of a place often has been evaluated by the usual (standard) factors and indicators characterising them. It is exactly the inclusion of standard indicators into the methodology of assessing the attractiveness for investments and business development that often led to the availability of official statistics. Indicators like number and structure of inhabitants (based on analysis of population pyramids), labour force, infrastructure, socio-economic environment, public sector, etc. become a standard feature that describes the attractiveness of the location. This problem is especially relevant in the analysis of the concept of attractiveness at the regional and urban levels. However, it lacks the dynamic approach combined with the approach to attractiveness as a dynamic concept and as the ability to ensure, through economic entities and authorities, that the location will be attractive.

One of the most commonly used methods of attractiveness assessment is the evaluation by index which is widely presented (Godlewska-Majkowska, 2013; Nikolova & Plotnikova, 2013; Yatsenko, 2016) in scientists' works. The benefits and feasibility of this method, as one of the most appropriate ways to assess complex issues, are recognised. In some works, the index did not only evaluate the attractiveness of a country, industry (Godlewska-Majkowska, 2013; Nikolova & Plotnikova, 2013; Yatsenko, 2016) or the attractiveness of a residential location (Bruneckiene, Zykiene, & Stankevičius 2016; Vidickiene, 2017), but also the intelligence, (Bruneckienė, 2014; Caragliu et al., 2011; Giffinger, 2015; Juceviciene & Jucevicius 2014; Liugailaite-Radzvickiene & Jucevicius, 2014; Sinkienė, 2016), competitiveness (Bruneckiene, 2009; Bruneckiene & Lopez Ventura, 2015; Bruneckiene & Sinkiene, 2015; Sinkiene, 2016), export (Bruneckiene, 2009; Meilienė & Snieška, 2010), and innovation of a location (Levickaite, Reimeris, & Zemaitis, 2011; Martinaityte & Kregzdaite, 2015). Other authors (Petraite & Ceicyte, 2014; Melnikas, 2013; Vasauskaitė & Krušinskas, 2009) discuss globalisation and other socio-economic phenomena.

Various attractiveness indexes are used for assessment, but in the vast majority of works index of attractiveness for business development in the context of smart development of a location, the level of which is lower than the level of the whole country, is missing.

### 3. Methodology

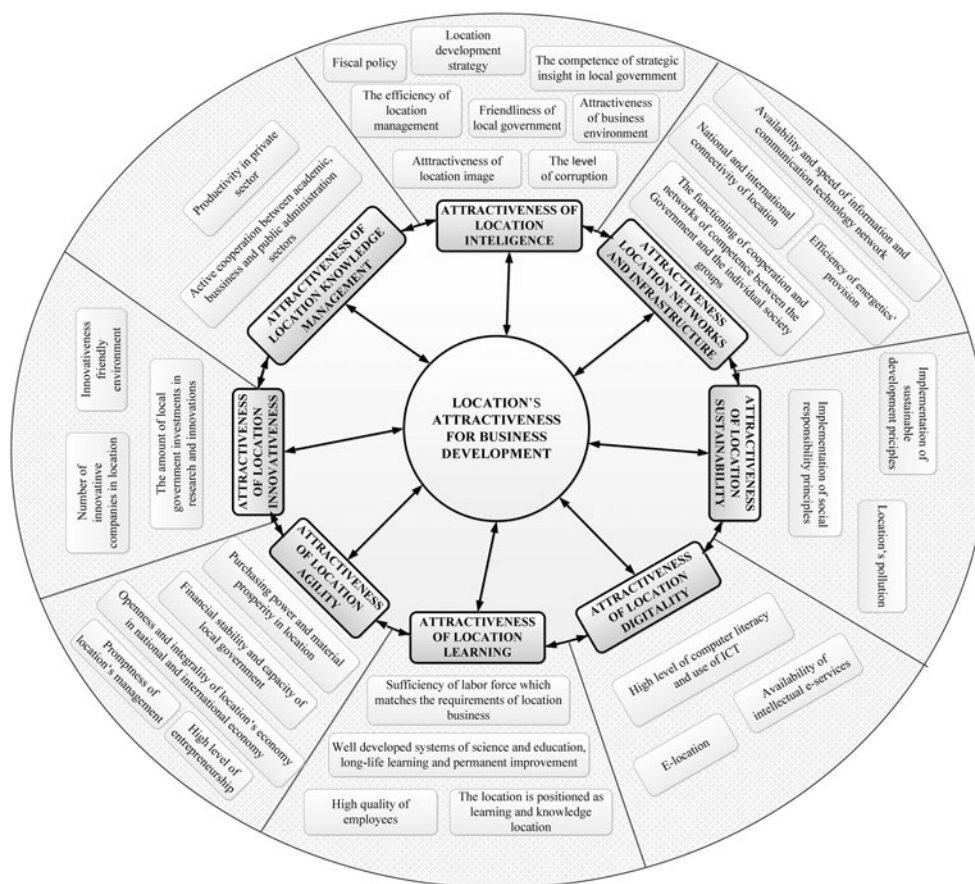
Analysis of scientific literature allows concluding that economic development of locations to a large extent depends on dynamic capabilities and smartness feature as this becomes an important prerequisite for achieving and sustaining attractiveness. Authors analyse location attractiveness as a dynamic process and smart development. Attractiveness is also analysed by some academic scholars as a permanent dynamic process, which allows concluding that location attractiveness to business is also interrelated with the elements of smartness. This explains why the location's attractiveness to business should be assessed by eight characteristics of the smart development: intelligence, knowledge-driving, learning, networking, innovativeness, agility, sustainability and digitality. Based on secondary research, authors define the location's attractiveness for business development in the context of smart growth as the location's ability to attract, develop and maintain business and investments by means of developed environment (consisting of intelligence, knowledge-driving, learning, networking, innovations, agility, sustainability and digitalisation factors) and smart operation of economic entities (private and public sector), which give them a competitive advantage over other entities. The research carried out by the authors of this article allowed to create a model of factors of the attractiveness of a location with regard to business development in the context of smart development (*LAB*), identifying key factors that determine the attractiveness of a location and grouping them together, taking into account their interrelationship and the impact on the overall attractiveness of the location.

In the *LAB* model, the factors that make a location attractive for business development are amalgamated into eight groups that specify smart development: (1) a group of factors determining the attractiveness of the location's intelligence; (2) a group of factors determining the attractiveness of the location's infrastructure and networking; (3) a group of factors determining the attractiveness of the location's coherence; (4) a group of factors determining the attractiveness of the location's digitalisation; (5) a group of factors determining the attractiveness of education in regard to a particular location; (6) a group of factors determining the attractiveness of the location's mobility; (7) a group of factors determining the attractiveness of the location's innovation; (8) a group of factors determining the attractiveness of how much the location is based on knowledge (see [Figure 1](#)).

The groups of individual factors that determine the attractiveness of locations emphasised in the model allow formulating these conceptual conclusions that characterise the concept of attractiveness.

1. Factors determining the attractiveness of an intelligence of a location, create conditions, form and encourage the ability of entities, found in a location, to assess the internal and external environment, see and predict the future, the emerging threats or emerging opportunities and use the received information while making the most effective decisions that allow to be at least a step ahead of the competitors.
2. Factors determining the attractiveness in regard to the network and infrastructure of the location, create conditions, form and promote the ability of entities in a location to use the opportunities offered by different types of networks,





**Figure 1.** The model of factors determining the location's attractiveness for business (LAB) development in the context of smart growth.

communicate with other social systems and individuals and to provide important resources, and achieve their goals.

3. Factors determining the attractiveness in relation to the coherence of the location, create conditions, form and promote the ability of the entities in a location to make decisions and implement them, combining the components of environmental, economic, socio-cultural and social responsibility and honesty.
4. Factors determining the attractiveness in regard to the digitalisation of the location, create conditions, form and promote the ability of the entities in a location for the acquisition of information, communication, network, justification of decisions, decision making and implementation to widely use information and communication technologies.
5. Factors determining the location's attractiveness in regard to learning, create conditions, form and encourage the ability of local entities and their networks to continuously learn and be able to learn.
6. Factors determining the attractiveness of location's mobility, create conditions, form and encourage the ability of local entities to achieve their goals by quickly reacting to changes caused by the external and internal environment.

7. Factors determining the attractiveness of location's innovation, create conditions, form and encourage the ability of local entities to create value and act by adapting innovation and new, better (non-standard) solutions.
8. Factors determining the attractiveness in regard to how much the location is based on knowledge, create conditions, form and encourage the ability of local entities to achieve their goals, adopt and implement decisions, create value or gain competitive advantage by applying the knowledge, innovations and scientific research.

The model aims to assess the ability of the location to exploit and/or create the factors that decide the attractiveness of a location for business development in the context of smart development by attracting, creating new ones or maintaining the existing businesses and investments in the area. It must be noted that the concept of a location's attractiveness for business development in the context of smart development is classified as multi-criterion, which is determined not by one, but by many factors; therefore, the *LAB* model should be viewed as a methodological tool that allows to analyse both the set of attractive factors and individual factors in the hierarchical system of other factors.

The model outlines the main factors that determine attractiveness identified through theoretical and empirical analysis; however, it is acknowledged that attractiveness is a changing state, that can be shaped by different factors at different times; this is why the model itself can be clarified and something new can be added to it, taking into account the specifics of the location and the period in question. The fact that the model can be supplemented expands its practical applicability capabilities, both on a national and international level.

In order to show the location as a complex, vibrant and open economic social system, the *LAB* model highlights the relationships between the factors and the mutual connection with the general attractiveness.

The concept of a location's attractiveness for business development in the context of smart development is of multi-criteria and can be characterised by both quantitative and qualitative expressions. This paper presents (see [Table 1](#)) specific quantitative indicators of a group of factors that form the component of attractiveness. Qualitative factors and their evaluation are fields for further research.

The goal of a location that is attractive for business development is to attract, create new business and investments, and maintain the existing ones (competitive local business on national and international level). The multi-criterion of the concept of attractiveness confirms the appropriateness of its evaluation indexes (see [Table 1](#)). Indicators incorporated in the model were selected from the scientific literature as most used for attractiveness and business development analysis.

The authors of this research recommend using their *LAB* model and assessing the location's attractiveness for business development in the context of smart growth through eight groups of factors consisting of 32 factors and 36 quantitative indicators.

All the eight groups have the same weight coefficient equal to 1 in order to avoid subjectivity interpreting results. As different number of factors is included in all groups, so their weight coefficients differ.

**Table 1.** Quantitative characteristics of factors determining the location's attractiveness for business development in the context of smart growth.

<b>Attractiveness in regard to the intelligence of the location</b>	<b>Quantitative indicators characterizing attractiveness factors (variable abbreviation)</b>
1.1. Local and international image of a location	1.1.1. GDP per capita (GDPCAP)
1.2. Location development strategy	1.6.1. Foreign direct investment per capita (FDICAP)
1.3. The friendliness of the local authority	1.6.2. Tangible investments per capita (matinv1gyv)
1.4. The competence of the local government's strategic insight	
1.5. Location management efficiency	
1.6. The attractiveness of business environment	
1.7. Tax policy	
1.8. Level of corruption	
<b>Attractiveness in regard to networking and infrastructure of the location</b>	<b>Quantitative indicators characterizing attractiveness factors</b>
2.1. Accessibility and speed of the Information and Communication Technology network	2.2.1. <i>The length of car roads (national and local) (autokelilig)</i>
2.2. The convenience of availability at national and international level	
2.3. The efficiency of energy supply	
2.4. Functioning of cooperation and competence networks between government and individual groups of society	
<b>Attractiveness in regard to the coherence of the location</b>	<b>Quantitative indicators characterizing attractiveness factors</b>
3.1. Implementation of the principles of sustainable development	3.2.1. Emission of pollutants into the atmosphere from stationary sources of pollution in 1 sq. km. (tersismet)
3.2. Pollution	3.2.2. The environmental pollution taxes per capita are paid and counted into municipal budgets (mopakplinka)
3.3. Implementation of social responsibility principles	
<b>Attractiveness in regard to the digitalisation of the location</b>	<b>Quantitative indicators characterizing attractiveness factors</b>
4.1. High level of computer literacy and ICT usage	4.1.1. Households that have internet access (namukinternet)
4.2. Accessibility of intellectual electronic services	4.1.2. Households that have a personal computer (namukkomp)
4.3. Electronic terrain	4.1.3. Part of people who used internet every day throughout the last three months (asminternet)
	4.1.4. <i>Part of companies, operating in the field of information and communication activities (imlrv)</i>
<b>Attractiveness of the location in regard to learning</b>	<b>Quantitative indicators characterizing attractiveness factors</b>
5.1. The systems of science and education, lifelong learning and lifelong development are developed	5.1.1. Number of people pursuing higher education (university and college students) per 1000 inhabitants (aukstissilavstudent)
5.2. The image of the learner and knowledge centre is formed	5.2.1. Part of population who have completed tertiary education (aukstissilav)
5.3. High-skilled workers	5.2.2. Average consumption expenditure per household member per month for education (vidislsviet)
5.4. Adequacy of the workforce that meets business needs	5.4.1. Part of the working age population (darbingyv)
	5.4.2. The population's domestic and international migration balance per 1000 inhabitants (migrac saldo)
	5.4.3. Average gross monthly earnings (vidmenbruto)
	5.4.4. Unemployment rate (nedarblyg)
<b>Attractiveness in regard to the mobility of the location</b>	<b>Quantitative indicators characterizing attractiveness factors</b>
6.1. The expedition of location management	6.2.1. The taxes per capita are paid and counted into municipal budgets (mokesclgyv)
6.2. The financial stability and capacity of public authorities	6.2.2. Municipal budget expenditure and income ratio

*(continued)*

**Table 1.** Continued.

6.3. The purchasing power of the location and the level of material well-being	(islpajantyky)
6.4. Openness and integrity of the location's economy in the national and international economy	6.2.3. <i>General government gross debt compared to GDP of the city (skola)</i>
6.5. High level of entrepreneurship	6.2.4. Part of the population living in households experiencing economic difficulties (eksunkum)
	6.2.5. Average annual ratio of recipients of social benefits and residents (socpasalposgavej)
	6.2.6. The number of social risk families per 1000 people (socrizseimos)
	6.2.7. Pension recipients per 1000 people of working age (pensijasgaunanciudalis)
	6.3.1. The ratio of income gap if compared to the capital (pajskirtsostine)
	6.4.1. Share of export of domestic goods in GDP (export)
	6.4.2. Revenue from export per capita (pajexport1gyv)
	6.5.1. Number of economic entities operating per 1000 inhabitants (veikianciosim)
	6.5.2. The number of companies undertaking bankruptcy per 1000 operating companies (bankrutim)
<b>Attractiveness in regard to the innovativeness of the location</b>	<b>Quantitative indicators characterizing attractiveness factors</b>
7.1. Environment that encourages innovation	7.1.1. Expenditure R&D ratio to GDP (islMTEP)
7.2. The abundance of innovative companies in the location	7.2.1. The part of companies that have implemented innovations (iminovac)
7.3. Investments that public authorities make in research and innovation	7.2.2. The part of companies that have implemented technological innovations (imtechnologinov)
	7.3.1. Expenditure R&D in higher education sectors (islMTEPaukstmoksl)
	7.3.2. Expenditure R&D in government sectors (islMTEPvaldzia)
<b>Attractiveness in regard to how much the location is based on knowledge</b>	<b>Quantitative indicators characterizing attractiveness factors</b>
8.1. Active cooperation between science, business and government	8.1.1. Employees, involved in the R&D higher education and government sectors (darbuotMTEP)
8.2. Productivity in the private sector	8.2.1. Added value, created during an hour actually worked (pridetvert1val)

Application of the designed model allows to perform empirical research of a location's attractiveness for business development in the context of smart growth, which provides results of a location's attractiveness for business development at a fixed point in time and dynamically, and in relation to other locations, identification of factors which increase or decrease a location's attractiveness for business development, allows forecasting a location's attractiveness for business development in the context of smart growth and a location's economic development, also evaluation of the effectiveness of attractiveness improvement strategies and measures.

#### **4. Panel data analysis for determining the role of quantitative indicators in attractiveness index**

These multi-criterion decision factors are incorporated in our *LAB* model allowing calculating the index of the attractiveness for business growth in smart development. As the first step of the factors selection, all these 36 quantitative indicators

characterising attractiveness factors, each of them for a 10 years period, use Lithuanian statistical data from 10 cross-sections, representing Lithuanian regions: Alytus, Utena, Telsiai, Taurage, Siauliai, Panevezys, Marijampole, Klaipeda, Kaunas, Vilnius, 3600 observations of annual data for the panel data analysis in total were analysed. EViews software was used.

It should be noted that the location for the analysis was selected only for demonstration of the methodology, and the model may be applied to any other location, if the necessary statistical data exists.

From Table 2 it may be observed that skewness and kurtosis of the data are significant, and this is characterised with a relatively high Jarque-Bera criterion. Large differences between minimum and maximum values are observed. Such data characteristics are determined by tremendous regional data differences. Cross-section techniques help to cope with this problem. Because here the cross-sectional units are identical over time, we are able to use panel data analysis.

In our paper we apply panel data analysis to determine the complex influence of change in each of the indicators characterising attractiveness factors on the gross domestic product per capita in the analysed region.

Using  $i$  to subscript the cross section, here, a country, and  $t$  to subscript the time period, the equation for a regression line is as:

$$y_{it} = a_i + \beta x_{it} + u_{it} \quad (1)$$

where:  $y_{it}$  - is a dependent variable, here, GDP;  $x_{it}$  - is an independent variable;  $a_i$  - is a separate intercept for each country, or, in other words, cross section fixed effects, partly reflecting the existence of unobservable variable  $z_i$  which is unique for each country and is not dependent on the time limits of the analysed period.

$u_{it}$  - is an error term similarly reflecting both, cross country and cross period fixed effects.

Such method enables us to calculate functions using panel least squares and autoregressive AR(p) model and cross-section and period both fixed by dummy variables.

Influence of lags of one (-1), two (-2), and three (-3) years were checked (an example of the independent variables selection is in Table 3). Panel data analysis of all these 36 quantitative indicators characterising attractiveness factors' statistical characteristics, based on a total of 3600 observations of annual data with different lags allowed extracting the eight most important quantitative indicators for further analysis. Their statistical data is presented in Table 4.

Performed selection of variables allowed to focus on the most important factors and the lags affecting a location's attractiveness for business growth measured by the GDP per capita growth (Table 5).

Table 5 statistics reveal that the biggest positive influence to a location's attractiveness for business growth measured by the GDP per capita growth had, with 2-3 years lags, average annual ratio of recipients of social benefits and residents; added value, created during an hour actually worked; average gross monthly earnings. The biggest negative influence was unemployment rate and the ratio of income gap if compared to the capital city.



**Table 3.** Dependent Variable: GDPCAP. Example of procedure of independent variables selection.

Criteria	Independent variables							
	FDICAP	FDICAP(-1)	FDICAP(-2)	FDICAP(-3)	PAJSKIRTSOSTINE	PAJSKIRTSOSTINE(-1)	PAJSKIRTSOSTINE(-2)	PAJSKIRTSOSTINE(-3)
C-Coefficient	85.07349	87.27307	87.38923	88.39376	90.09455	85.36460	80.81417	79.66703
C-Std. Error	0.716782	0.611943	0.643353	0.697415	4.289146	3.626976	3.845363	4.150377
C-t-Statistic	118.6881	142.6164	135.8341	126.7448	21.00524	23.53602	21.01600	19.19513
C-Prob	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Coefficient	-0.000135	0.000234	0.000375	0.000227	-0.066524	0.030470	0.093246	0.116049
Std. Error	0.000198	0.000170	0.000175	0.000187	0.053117	0.049976	0.047808	0.051628
t-Statistic	-0.682159	1.376159	2.149189	1.219130	-1.252409	0.677468	1.950427	2.247798
Prob	0.4969	0.1726	0.0350	0.2274	0.2137	0.5001	0.0551	0.0282
R-squared	0.967811	0.977921	0.978332	0.977518	0.968204	0.977527	0.978096	0.978714
Adjusted R-squared	0.960578	0.972677	0.972839	0.971354	0.961058	0.972190	0.972543	0.972877
S.E. of regression	5.872073	4.773468	4.780347	4.906746	5.836200	4.815843	4.806312	4.774476
Sum squared resid	3068.830	1822.880	1622.472	1492.722	3031.450	1855.388	1640.145	1413.328
Log likelihood	-339.1547	-287.0440	-257.8398	-230.5683	-338.4806	-287.9278	-258.3273	-228.3821
F-statistic	133.7980	186.4899	178.0967	158.5739	135.5027	183.1487	176.1351	167.6866
Prob(F-statistic)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Mean dependent var	84.76818	87.80000	88.24889	88.91875	84.76818	87.80000	88.24889	88.91875
S.D. dependent var	29.57486	28.87813	29.00584	28.99065	29.57486	28.87813	29.00584	28.99065
Akaike info criterion	6.548267	6.140880	6.151996	6.214207	6.536011	6.158556	6.162830	6.159553
Schwarz criterion	7.063813	6.661914	6.679733	6.750163	7.051557	6.679590	6.690567	6.695509
Hannan-Quinn criter.	6.757375	6.351751	6.364810	6.429087	6.745119	6.369428	6.374433	6.374433
Durbin-Watson stat	0.788439	0.667566	0.802348	0.697179	0.785277	0.620551	0.750807	0.720329

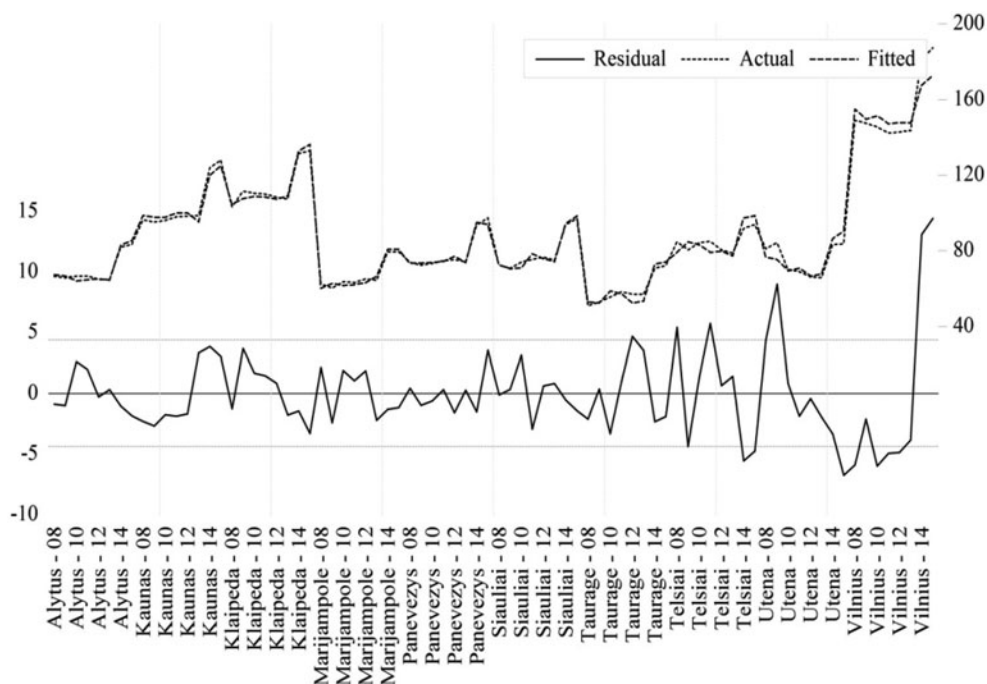
**Table 4.** Statistics of selected independent variables. Dependent Variable: GDP/CAP.

Criteria	Independent variables									
	FDICAP(-2)	PAJSKIRTOSTINE(-3)	MIGRACSALDO(-1)	PRIDETVERTIVAL(-3)	SOCPASALPOSGAVE(-3)	VEIKANCIOSIMI(-3)	NEDARBYG(-2)	VIDMIENBRUTO(-2)		
C-Coefficient	87.38923	79.66703	89.11084	82.57206	91.37346	87.31737	89.38319	73.21752		
C-Std. Error	0.643353	4.150377	0.799369	2.427619	1.782590	0.738433	2.142937	4.413361		
C-t-Statistic	135.8341	19.19513	111.4764	34.01360	51.25881	118.2468	41.71060	16.58997		
C-Prob	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
Coefficient	0.000375	0.116049	0.000437	0.615337	-0.540126	0.000193	-0.101701	0.029121		
Std. Error	0.000175	0.051628	0.000215	0.229785	0.373383	6.33E-05	0.186415	0.008499		
t-Statistic	2.149189	2.247798	2.029553	2.677878	-1.46574	3.041910	-0.545559	3.426349		
Prob	0.0350	0.0282	0.0457	0.0095	0.1531	0.0034	0.5871	0.0010		
R-squared	0.978332	0.978714	0.978505	0.979366	0.977731	0.979969	0.977019	0.980197		
Adjusted R-squared	0.972839	0.972877	0.973400	0.973708	0.971625	0.974476	0.971193	0.975176		
S.E. of regression	4.780347	4.774476	4.709906	4.700796	4.883482	4.631602	4.923085	4.570013		
Sum squared resid	1622.472	1413.328	1774.657	1370.044	1478.601	1330.008	1720.810	1482.837		
Log likelihood	-257.8398	-228.3821	-285.7035	-227.1379	-230.1881	-225.9516	-260.4878	-253.7901		
F-statistic	178.0967	167.6866	191.6717	173.0996	160.1231	178.4201	167.6936	195.2390		
Prob(F-statistic)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		
Mean dependent var	88.24889	88.91875	87.80000	88.91875	88.91875	88.91875	88.24889	88.24889		
S.D. dependent var	29.00584	28.99065	28.87813	28.99065	28.99065	28.99065	29.00584	29.00584		
Alkaike info criterion	6.151996	6.159553	6.114070	6.128448	6.204702	6.098790	6.210840	6.062002		
Schwarz criterion	6.679733	6.695509	6.635104	6.664404	6.740658	6.634746	6.738578	6.589739		
Hannan-Quinn criter.	6.364810	6.374433	6.324941	6.343328	6.419582	6.313671	6.423655	6.274817		
Durbin-Watson stat	0.802348	0.720329	0.658301	0.787431	0.694680	0.769456	0.643451	0.928695		



**Table 5.** Panel estimation of selected independent variables relation to GDP per capita.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	69.53114	12.11060	5.741348	0.0000
FDICAP(-2)	-0.000111	0.000315	-0.354366	0.7244
NEDARBLYG(-2)	-0.363834	0.216739	-1.678677	0.0989
PAJSKIRTOSTINE(-3)	-0.035541	0.078535	-0.452545	0.6527
PRIDETVERT1VAL(-3)	0.165256	0.406777	0.406256	0.6861
SOCPASALPOSGAVEJ(-3)	1.505215	0.657582	2.289014	0.0259
VEIKIANCIOSIM(-3)	0.000330	0.000174	1.896886	0.0631
VIDMENBRUTO(-2)	0.031350	0.016248	1.929483	0.0588
MIGRACALDO(-1)	0.000295	0.000248	1.191062	0.2387
R-squared	0.984036	Mean dependent var		88.91875
Adjusted R-squared	0.977070	S.D. dependent var		28.99065
S.E. of regression	4.389911	Akaike info criterion		6.046802
Sum squared resid	1059.923	Schwarz criterion		6.791185
Log likelihood	-216.8721	Hannan-Quinn criter.		6.345246
F-statistic	141.2640	Durbin-Watson stat		1.051979
Prob(F-statistic)	0.000000			

**Figure 2.** Panel estimation of selected independent variables relation to GDP per capita: actual, fitted and residual.

A graph of panel estimation of the selected independent variables' relation to GDP per capita (Figure 2) disclose a good match between actual and fitted by panel estimation procedure data.

## 5. Conclusions

Modern advanced post-industrial economies with dominating service sectors are often characterised as aiming to become smart economies in solving new challenges of

globalisation processes and strategies and trends of contemporary business development. Such encounter of the changing environment is not properly reflected in the existing literature of location attractiveness for business development. The context of smart development must be integrated in the model of location attractiveness for business development, thus reflecting a new dynamic approach answering the challenges of the changing global environment.

Various attractiveness indexes are used for location assessment, but in the vast majority of the literature, index of attractiveness for business development in the context of smart development of a location is not provided.

No researchers have employed an integrated approach towards the evaluation of a location's attractiveness for business development. The matters of location attractiveness have not been researched in the context of smart growth treated as a new medium (conditions), where locations compete for investment, new jobs, human resources, technologies, knowledge and other factors.

We have presented the methodological principles for evaluating the location's attractiveness for business development in the context of smart growth as a basis for the factor model (LAB). The LAB is created by us as a factor model, allowing calculating the index of the location's attractiveness for business growth in smart development according to the array of factors and their indicators.

In the LAB model, the 36 factors that make location attractive for business development are condensed into eight groups that specify smart development: a group of factors determining the attractiveness of the location's intelligence; a group of factors determining the attractiveness of the location's infrastructure and networking; a group of factors determining the attractiveness of the location's coherence; a group of factors determining the attractiveness of the location's digitalisation; a group of factors determining the attractiveness of education in regard to a particular location; a group of factors determining the attractiveness of the location's mobility; a group of factors determining the attractiveness of the location's innovation; a group of factors determining the attractiveness of how much the location is based on knowledge.

Important implications of the model for managers and decision makers is that application of the designed model allows to perform empirical research of a location's attractiveness for business development in the context of smart growth, which provides results of a location's attractiveness for business development at the fixed point in time and dynamically, and in relation to other locations, identification of factors which increase or decrease a location's attractiveness for business development.

An example of panel data analysis aimed at statistical evaluation of the significance of the selected factors for the evaluation of the location's attractiveness for business development in the context of smart development is presented. As the first step of the factors selection, all these 36 characterising attractiveness factors are quantitative indicators, each of them including a 10 years period, extracted from Lithuanian statistical data, grouped by 10 cross-sections representing all Lithuanian regions; 3600 observations of annual data for the panel data analysis in total, were analysed.

The analysis disclosed that the biggest positive influence to a location's attractiveness for business growth measured by GDP per capita growth had, with 2–3 years lags, average annual ratio of recipients of social benefits and residents; added value,

created during an hour actually worked; average gross monthly earnings. The biggest negative influence was unemployment rate and the ratio of income gap if compared to the capital city. The results of panel data analysis suggested the need for additional evaluation of qualitative attractiveness factors.

Limitations. The presented LAB model is created for evaluation of location attractiveness at a sub-national level. Therefore the model can be applied both on the national and international levels after substituting and revising its indicators considering the specific nature and period analysed.

The authors will focus on qualitative analysis of the model, integrating results of expert evaluations and surveys for model expansion and provision of integrated methods in future research.

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