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DEVELOPMENT OF A MARKET TREND EVALUATION SYSTEM FOR POLICY MAKING

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Abstract

The previous economic crisis has increased the attention of government to focus their activities more on economic stability. The development of government subsidies requires an analytically based analysis, one which would identify problematic areas of regional development more precisely. However, to monitor market changes in a highly dynamic market is time consuming and inefficient. Without proper market monitoring, the level of competitiveness within regions might decrease in the long run. Thus, the goal of the article is to establish the framework of a market trend monitoring system. To achieve this goal, the research methodology consists of a scientific literature analysis, an analysis of available data infrastructure for market trend analysis, and a statistical analysis together with a machine learning approach. The authors of the publication propose a market monitoring framework which would provide an infrastructure for evidence-based policy recommendations for government institutes and might provide guidelines of how to increase their competitiveness. A case study of real estate data and macroeconomic indicators of Lithuania was conducted, during which a clustering algorithm was applied to identify groups in Lithuania. The 60 municipalities of Lithuania were grouped into 4 clusters in terms of noteworthy relationships between industrial development and population size. In 3 of the clusters, the relationship of industrial growth and population was direct. In cluster 4, however, the relationship was opposite, a result which requires a further analysis of infrastructure and industrial sectors to provide more precise policy recommendations. The theoretical contribution and findings from the case study provides grounding to develop the market monitoring system.

Keywords: evidenced-based policymaking, system thinking, market trends, competitiveness, regional development
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1. INTRODUCTION

Recent economic crises have provided the motivation to develop a market monitoring system which would allow policy makers and business to make analytically based decisions. Without evidence-based policy recommendations, the levels of competitiveness within regions might

decrease. Monitoring of market trends is essential for strategic planning, which an effective infrastructure development of government and business depends on. Market monitoring depends on various aspects such as finance, industry and real estate markets. The real estate sector is an important aspect of the country's economic development related to residential, government and business growth (Krajnakova et al., 2018). The main category integrating the market is real estate, as this aspect influences industrial, social and economic development. Thus, developing a market trend monitoring system with a focus on real estate is essential to form credible assumptions.

Nowadays, data platforms are being developed and used to monitor the market from the separate perspectives of real estate, finances and industry. For example, some private companies such as Zillow, Geophy, Zenplace, and Skyline integrate multiple data sources and use artificial intelligence to evaluate real estate value (Kaggle, 2018; Shutterstock, 2017; Zillow, 2008; Geophy, 2019; Zenplace, 2019; SKYLINE.AI, 2019). A number of government institutes have also developed such integrated monitoring platforms. For instance, the Russian firm Sberbank integrates real estate and macroeconomic indicators for this analytic purpose (Sberbank, 2016). Organizations focus on integrating data sources and using algorithms to analyse them, however, the practical application of insights is needed, thus collaboration between policy makers, private companies and researchers should be promoted. Without proper integration of all agents involved in the decision making, the insights obtained from such a system might not be successfully implemented and regions would not increase their competitiveness. An example of such an initiative is Inter-American Development Bank, which focuses on the evidence-based policy making and integration of industry, researchers and policy makers. Nonetheless, the problem is that an integrated market monitoring platform which would allow the systematic analysis of market trends has not been established in the Baltic region.

There is a tendency to integrate multiple disciplines in conducting analysis to provide more value-added insights. Athey & Luca (2019) have indicated the growing demand for econometricians at technological companies, which could allow more integrated collaboration between policymakers and companies. Another tendency is the growing computation power and complexity of algorithms such as machine learning and agent-based modelling. It is important to view the policy making process as a system from the perspective of economics complexity (Moersch, 2013). The implementation of such methodologies would allow for more precise economic analysis and evidence-based decision recommendations for policy makers (van der Hoog, 2017). Thus, for the efficient development and usage of multiple data sources, a multidisciplinary team and a close collaboration between government, business and researchers is needed. This approach would allow regions to maintain a higher level of competitiveness than before stemming from the ability to constantly monitor trends and maintain more flexibility to adjust to them than is possible without a proper market trend monitoring system.

The goal of this paper is to establish the framework of a market trend monitoring system. The novelty of the research is that rapidly increasing data quantity and the variety of sources allow for their integration and analysis using certain tools to extract insights for regional level recommendations. The integration of a rich variety of data sources and the application of algorithms can help extract useful insights with which to estimate the market trends more efficiently, and as

the result to provide evidence-based policy recommendations to help increase the competitiveness of regions. Nevertheless, there is not one single system which would integrate and analyse data sources from industry, real estate and social aspects in the Baltic region. From a systems theory perspective, the integration of such approaches would provide evidence-based insights for regional development. To fulfil this goal, several objectives must be accomplished:

1. To overview the theoretical background for evidenced-based policy making along with driving factors such as the development of algorithms and interdisciplinarity
2. To develop the framework of a market trend monitoring system by considering data sources, algorithms and possible applications
3. To provide evidence-based regional development recommendations by conducting a case study of Lithuania

In the first part of the publication, an analysis of theoretical literature regarding evidence-based policy making is provided, with the second part presenting methodology, and the third the market monitoring framework. The final section of the article provides a case study of Lithuania by applying a machine learning approach to macroeconomic indicators.

2. THEORETICAL BACKGROUND

Evidence-based policy making first started to be used in education and the medical industries, since it provides a more controlled environment for analysis as well as the fact that historical data has been accumulated due to institutional regulations. Such an analysis helps to provide more efficient education or health care services (Kerr, 1997; Slavin, 2002). For example, Australian health services employ evidence-based policymaking to provide sustainability in health care by allocating resources effectively (Harris et al., 2017). Over the years, evidence-based policymaking has come to be used in other industries. For this reason, the concept of evidence-based policymaking has obtained a more precise definition. Evidence-based policymaking is defined as "help[ing] people make well-informed decisions about policies, programmer and projects by putting the best available evidence from research at the heart of policy development and implementation" (Marchi et al., 2012). While data and analytical method integration is important, application domain knowledge is also needed (Gil-garcia et al., 2018). Misuraca & Osima (2014) have indicated a need to increase evidence-based policymaking for industrial development, as the world population is estimated to reach 9 billion people by 2050, which requires increasing production output by 60% and improving urbanization development. For this purpose, they indicated that agent-based models can be developed to simulate and improve the decision making of individual households, business and other investors working within urban real estate markets (Gascó-Hernández, 2014). Daniell et al. (2016) describe how business analytics has been used in the consultation and private sector. However, only few government institutes have established a systematic way to use data, evidence, statistics and machine learning methods for policymaking. Thus, the integration of policymakers, data and machine learning approaches will help improve the utilization of resources and achieve competitiveness in the long run.

To establish a market monitoring system and provide evidence-based policy recommendations, firstly, it is important to integrate various sources of data. In recent years, both data variety and volume have increased exponentially. Along with digital records of citizens, the use of service apps, social media, digital sensors, and other digital footprints, big data also give policymakers insights into citizen choice and is, therefore, potentially supportive of public value such as participation and openness (Ingrams, 2018). Veenstra & Kotterink (2017) state that data can be used for the real time monitoring of policy. Nevertheless, the researchers point out challenges regarding the capturing of various data sources, as well as in creating an infrastructure for ensuring interoperability as well as sense-making and interpretation. Giest (2017) also indicated that big data for policymaking is essential, however, there are problems due to institutional barriers and capacity bottlenecks. In less developed countries, problems related to data integration could be classified from several aspects. Firstly, part of the data that are gathered is not available for public use. Secondly, the data that is available does not have a programming interface and usually is available in a simple spreadsheet format. Lastly, there is a limited amount of data gathered in less developed countries when compared to developed countries. Thus, the development of a market monitoring system will not have only technical, but also political challenges from the perspective of integrating data, and in the future, of implementation decisions. Höchtl et al. (2016) indicated that currently there are new ways of obtaining data, new algorithms to process the data and opportunities to redesign the government process and include more players in to policymaking. Thus, the improvement of data infrastructure in regard to openness and extraction is needed to allow the real-time evidence-based policy recommendations, otherwise regions might not increase their competitiveness by using the proposed market trend monitoring system.

To utilize the market monitoring system, it is important to promote a collaboration between enterprises, research and government. From this aspect, there will be institutional problems related to bureaucracy and different levels of decisions in institutes. Gil-Garcia et al. (2018) indicated that from a public management perspective, digital government could be considered an essential aspect of innovation, co-production, transparency, and the generation of public value. For example, in the finance sector, usually banks are responsible for interest rate determination, the government establishes real estate taxes, while the valuators and brokers evaluate the price of real estate. In this case, all three players of the real estate market should be integrated allowing making better decisions. Ferro et al. (2013) developed a social media platform for a telemedicine programme which involves multiple policy makers for different hierarchical roles. From the research perspective, the evidence-based policymaking requires using a system approach and complexity theory for integrating multiple organizations in the decision-making process. Freeman et al. (2014) amplified the necessity to integrate multiple policy makers together with the evidence-based approaches to provide valid recommendations for waste management. Thus, the involvement of government, researchers and business are essential to implement for evidence-based policies in order to increase competitiveness for regions.

The integrated data platform, together with different policy makers, business and researchers could be used to analyse regional trends and provide development recommendations accordingly. In the future by using Internet of Things, these indicators could be tracked practically in real time. There are various indicators developed, which include not only economic data, but also

expert surveys such as manufacturing index, logistics performance index, competitiveness index, innovation index and so on. However, some of these indexes are not adapted to specific regions. For example, Manzhynski et al. (2016) adapted the sustainability performance measurement approach for the Baltic sea region.

The integrated data platform could provide a platform for various sector analyses. For example, Copiello & Grillenzoni (2017) developed a spatial model of consumer choice of energy use for heating. Omelchuk (2018) conducted a real estate analysis for resident household purchasing possibilities and provided recommendations for banks of how to increase the ownership ratio of households in the country. Wright (2017) used economic data to compare the Caribbean development of industry and education regarding productivity and provided improvement recommendations for employment training and social environment assurance. With the integrated data, econometric analyses are possible. For example, traditional approaches usually focus on using regression analysis, general equilibrium models and so on. For example, Rubio and Comunale (2018) conducted a case study of Lithuania to analyse different macro prudential policies on financial stability. Ramanauskas & Karmelavicius (2018) used a dynamic stochastic general equilibrium to analyse monetary policy of an open economy.

Moersch (2013) described agent-based modelling as a novel approach for economics research. Arsanjani et al. (2013) conducted an agent-based model of urban growth to simulate the expenditure of cities and to provide recommendation to policy makers accordingly. Li et al. (2019) integrated agent-based modelling with reinforcement learning to improve resident's decision for household placement and thus simulated the growth of Nanjing, China. Kaviari et al. (2019) simulated urban growth by integrating agent-based modelling methodology and game theory to reproduce competition among agents for a different land type. Zhang et al. (2015) developed an agent-based model of urban growth by integrating industrial development indicators in the model. Ustvedt (2016) developed an agent-based model of Norwegian housing market, of which goal is to see how the metropolitan housing market is influenced by new policies from the perspective of economic stability. Tian & Qiao (2014) integrated agent-based modelling methodology with analytical hierarchy process method to simulate complex decision-making process in urban development. The model compared different policy approaches to urban development promotion. Other research focused on agent-based modelling approaches more from financial regulation perspective, such as interest rates, macro prudential regulations, industrial development and so on (Ge, 2017; Axtell et al., 2014; Knossow et al., 2012). However, the main difficulty in applying agent-based modelling is to define agent behaviour based on empirical data. Thus, the integrated data platform for regional comparison could provide a tool for developing agent-based models for policy making.

3. METHODOLOGY

The first part of the research consists of a various data sources analysis for the development of the market trend monitoring system. The selection analysis of the data sources consisted of two aspects. First, we focused on theoretically needed data, which could be applied in analysing regional trends. Second, overviewed the integration possibilities of the data sources. For example,

a constant update of data without clear technological integration and automation might lead to loss of competitiveness.

The case analysis is based on Lithuania. For the analysis of real estate objects, the sub-set of historical data of the flats and lots of 2008-2017 was selected. The macro indicators, the data of which during the period of 2008-2017 were selected for further analysis are as follows: Turnover according to the place of carrying out activities (non-financial enterprises), Number of flats the construction of which was completed, Number of new residential buildings the construction of which was completed, Number of new non-residential buildings the construction of which was completed, Wages (monthly), Number of employees, Coefficient of vital senility, The emigrants, The born, Density of population at the beginning of the year, The immigrants, The dead, The Number of permanent residents at the beginning of the year, Expenses of municipalities budgets, Income of municipalities budgets, Territory (the area of the land), Direct foreign investments at the end of the period, Number of registered fires. The number of municipalities in Lithuania is equal to 60, which are considered to be separate regions in the analysis. The data was obtained from The Lithuanian Department of Statistics.

The macroeconomic data were gathered by applying a k-mean algorithm, while when selecting the numbers of clusters, the elbow method was applied. Prior to the clustering analysis, the data had been scaled, and aggregated by a municipality. Afterwards, main descriptive statistics of the clusters were provided and visualized.

4. RESULTS

4.1. THE FRAMEWORK OF MARKET TREND MONITORING SYSTEM

Based on the previous literature review, it can be seen that the market trend monitoring system should not only be based on real estate sector. Thus, the platform should be integrated to other sectors such as economy, audit, industrial development and so on. The integration of multiple perspectives would allow utilizing the developed platform more effectively. The partners of such a market monitoring system could consist of scientific institutes, where data could be analysed and the insights related to country development be provided. The research institute could also develop and create new algorithms for analysis and data extraction. The development of a market trend monitoring system is important for several reasons. Firstly, growing data size, data variety and artificial intelligence application is creating new possibilities for evidence-based policy makers. Research institutes are promoting interdisciplinary research, thus this platform could help to integrate finance, economic, informatics, management and energy scientific fields. The users of such a market monitoring system could be government institutes, residents and investors, which agents' activities should be integrated to improve regional development. The conceptual framework of the market trend monitoring system is presented in Figure 1.

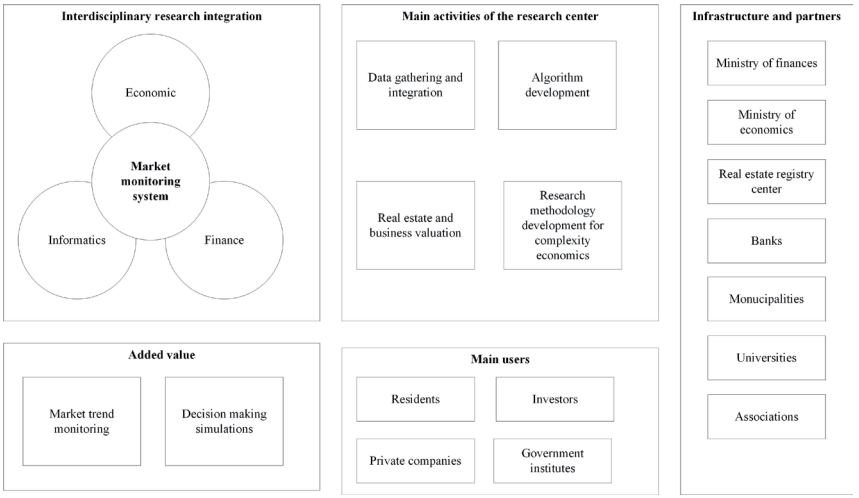

Fig. 1 – The framework of the market trend monitoring system. Source: own research

The maintenance and further development of the market trend monitoring system would require establishing a research facility responsible for various activities (Table 1).

Tab. 1 – The activities of the research centre. Source: own research

Category	Description
General functions	1.Data archival storage and management; 2.Constantly renewed market indicators; 3. Periodic surveys of expert valuation;
Development of methodology	1.Improvement of methodology of setting real estate value; 2. Improvement of methodology of business valuation; 3. Application of complexity theory along with agent-based modelling for those who take political decisions;
Organisation of seminars	1.Teaching the built platform; 2.Learning to use the renewed methodology of real estate valuation; 3. Explanation of theoretical access as complexity economics, political decisions grounded on analytical basis and similar.
Development of algorithms	1.Employment of agent-based modelling following real data; 2.Employment of reinforcement learning in taking decisions; 3.Algorithms of retrieval of exceptions aiming to establish tax evasion; 4.Algorithms of evaluation of taxes and other political decisions; 5.Algorithms of view recognition aiming to extract useful information from photos and other visual material.

The research centre would also integrate multiple scientific fields. From one perspective, finance sector would involve renewal of valuation methodology of real estate and business. From economic perspective, it would involve competitiveness analysis related to regional development for residents and private companies. The last scientific field is related to informatics, which is based on algorithm and mathematics aspect. The integration of these research fields would enable to develope economic models for regional development recommendations. The integration of data from multiple countries would allow considering the effect of economic inertia. Economic inertia means that some decisions can lag behind before the influence of the decision can be seen on the country level. Thus, some decisions that have been made in several countries could influence the market in another country, especially if the countries are related geographically or financially.

The market trend monitoring system should integrate data from mainly two perspectives. From the real estate perspective, it is mainly related to demand of real estate and economic cycle. The indicators important for these aspects depend on the purpose of the real estate object, which could be classified to agriculture, residential, industrial, commercial and other. The factors influencing real estate demand could be listed as follows':

1. Number of residents;
2. Amount of income;
3. Opportunities of getting employed;
4. Level of unemployment;
5. Ratio of landlords and renters;
6. Number of unrented premises;
7. Level of saving;
8. Level of getting loans;
9. Sales turnovers;
10. Directions of cities growth and expansion of infrastructure;
11. Road infrastructure;
12. Topography, landscape;
13. Burden of taxation;
14. Cultural and educational objects;
15. Safety infrastructure (fire services, emergency medical service, police).

It is also important to monitor the economic situation in the region as the purchasing power of companies and residents could change depending on the economic situation. Time series clustering algorithm could be used to track the economic cycle and adjust the provided recommendations accordingly (Brandmaier, 2015), (Montero & Vilar, 2014). To identify the economic cycle, it is needed to consider the following factors:

1. Quantity and quality of the competing objects;
2. Scale of new construction;

3. Prices of undeveloped land and its supply;
4. Costs of construction and territories development;
5. Number of sold objects;
6. Number of landlords and renters;
7. Not let floor-space and areas;
8. Opportunities to employ the objects for other destinations;
9. Opportunities of financing construction;
10. Regulation of construction and other laws.

The integration of economic, industrial and real estate indicators together with demand and supply trends can provide valid insights into strategy developments regarding regional competitiveness. To monitor the listed factors, various data sources should be integrated within the market trend monitoring system (Table 2).

Tab. 2 – Data source types. Source: own research

Category	Data Type
Industry and Economy	Macroeconomic indicators
	Industrial sector indicators
	Stock prices
	Statistics of the prices of goods and raw materials
Information on the Real Estate Market	Information of the Centre of Registers about purchases / sales
	Information on real estate supply
	Expert information on the valuation of real estate objects
Information on the Infrastructure of the Region	Orthophotos
	Transport information
Other unstructured data	Planned infrastructure projects
	Information from related institutions

Once the data has been gathered, it could be analysed by different mathematical algorithms depending on the analysis goal (Table 3).

Tab. 3 – Algorithm application based on the data source. Source: own research

Group of Methods	Group of Data
Time series analysis	Macro indicators
Time series clusterisation	Macro indicators
Image analysis	Orthophotos
	Photos of the object

Interpolation	Macro indicators
	Transport information
Regression analysis	Information of the Centre of Registers on purchases / sales
Artificial neural networks	Information of the Centre of Registers on purchases / sales
	Photos of the object and other important information
	Macro indicators
Artificial neural networks, reinforcement learning	Information of the Centre of Registers on purchases / sales

The development of a market trend monitoring system would from an integrated platform to provide evidence-based policies and could be used by various organizations to develop their own analytical tools. The development of such a system would increase the productivity of research, since the available data would be gathered in one place, with methodological guidelines provided. In the next chapter, an example of a regional indicator analysis will be provided in order to reveal the possibilities of a market trend monitoring system.

4.2. THE CASE OF LITHUANIA FOR A REGION COMPARISON AND POLICYMAKING

In the first step, all data were gathered without separating municipalities, although the results received divides the municipalities into several groups, i.e. main cities and suburban regions. Thus, further configuration was performed by eliminating the larger cities such as Kaunas, Vilnius and Klaipėda from the analysis. After the elimination of the municipalities, the clustering analysis was repeated. By using the elbow method, the number of clusters was set to 4.

Tab. 4 – Distribution of municipalities by year and identified cluster. Source: own research

Cluster ID	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	6	12	27	16	17	32	29	23	22	20
2	43	37	21	30	29	10	8	13	13	17
3	3	3	4	6	6	10	15	16	17	16
4	2	2	2	2	2	2	2	2	2	1

Table 4 illustrates the distribution of municipalities per year. It can be seen that cluster 1 and 2 are larger while clusters 3 and 4 are smaller.

Tab. 5 – Descriptive statistics of main indicators by cluster. Source: own research

Indicator	Cluster 1			Cluster 2			Cluster 3			Cluster 4		
	Mean		SD	Mean		SD	Mean		SD	Mean		SD
Demographic age dependency ratio	150	±	37	135	±	29	126	±	26	127	±	11
Births, number	164	±	70	306	±	88	453	±	117	1011	±	117
Deaths, number	314	±	149	538	±	114	643	±	127	1285	±	81

Direct Foreign Investment, MLN/EUR	11	±	21	15	±	25	101	±	221	136	±	79
Emigrants, number	270	±	194	456	±	294	795	±	364	1987	±	969
Immigrants, number	93	±	77	120	±	82	291	±	116	787	±	599
Municipalities expenditures, thousand EUR	15575	±	5755	24528	±	4969	37791	±	8616	73542	±	9624
Municipalities income, thousand EUR	15088	±	5560	24032	±	4908	36785	±	8474	72888	±	11723
Employees, number	3278	±	2468	3941	±	3970	12084	±	6528	30949	±	22289
Population, number	18286	±	7995	33789	±	8152	46752	±	11665	104325	±	6895
Population density, km/people	40	±	73	31	±	41	212	±	471	1649	±	341
Real estate price, EUR	30009	±	63683	23027	±	24598	29042	±	24655	43112	±	36492
Revenue of companies, thousand EUR	135701	±	102691	283070	±	200053	1067412	±	1530068	2371759	±	701762
Wage, EUR	440	±	246	294	±	277	558	±	208	422	±	301

Table 5 presents the descriptive statistics by cluster group. For example, it can be seen that the age dependency ratio is higher in clusters 1, 2 and 4 clusters, while in cluster 3 it is the lowest. Nevertheless, in all cases, the ratio is higher than 100, which indicates that over 100 elderly people are covering 100 younger persons, a ratio which indicates problems in the future. Births and deaths show a similar trend in all cluster groups. It is important to note that in cluster 1 – 3, the birth rate is very low, which will cause problems in the future. A low birth rate and the growing number of immigrants will cause even more problems to the suburban regions.

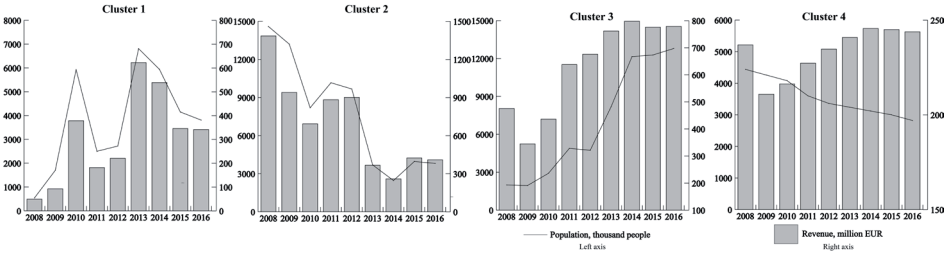

Fig. 2 – Population (left axis) and Revenue (right axis) of enterprises by clusters. Source: own research

This problem can be analysed from the perspective of the labour market, population and infrastructure. From one perspective, we could emphasise that the regions are becoming economically and socially weaker due to the decreasing population. However, the declining population might not be the root problem, but the consequences. The root problem of this is infrastructure

and industrial development. Job positions with lower pay and status lead to a less satisfied population. For example, we can see that in cluster 1 and 2, population size and revenue are declining together; in cluster 3 we see a trend toward growth. However, in cluster 4, we can see that revenue is growing and population size is declining (Figure 2). For example, some regions have reduced both population size and industrial growth. Nevertheless, the regions with an indirect dependency show a competitiveness advantage when compared to other regions. This approach might help to analyse in greater depth the situation as well as provide guidelines for other regions to increase their competitiveness. Thus, such a market monitoring system would help to analyse the trends of the regions more precisely and compare them better by providing a more precise and larger overview of industrial sector development. Accordingly, recommendations might be provided as to what kind of financial aid the government might provide to more strongly attract the work force in the regions. Moreover, a more precise analysis might be conducted to compare the infrastructure of the regions, which is important to industrial development.

5. CONCLUSIONS AND DISCUSSION

The application of machine learning in econometrics remains an evolving field with only a limited amount of research, although it is estimated that it will come to be more broadly applied in future research (Varian, 2014). In spite of rapid growth of machine learning, the collaboration between computer science and economists is still evolving: "it remains to conclude that machine learning has certainly advanced econometric techniques but a lot of work remains to speed up their introduction into econometrics" (Thesling, 2016). Nevertheless, the application of machine learning is estimated to enrich economic research by providing a useful way to obtain a one-dimensional statistic that summarizes a large amount of information about the entities being studied (Einav & Levin, 2013). Such machine learning approaches have been implemented in economics, but results are reflected in only a limited number of research studies. Research that has applied clustering algorithms for macro indices remains limited. Řezanková (2014) conducted a cluster analysis to the macro level of EU consumers. Kembe (2017) used a clustering approach to identify key macro indicators contributing to economic growth in Nigeria. Research by Augustyński & Laskoś-Grabowski (2017) focused on the EU, but only from the perspective of gross domestic product. None of these approaches have been focused on a regional comparison of macroeconomic indicators and real estate data.

Our research indicated that in recent years evidence-based policy making has gained much recognition due to the growing volume and variety of data involved. Increasing computational power and the development of artificial intelligence algorithms has further developed evidence-based policy making approaches. For this reason, the authors of this paper emphasise the necessity to develop a market monitoring system which would integrate various sources of data and provide a platform for a collaboration among government, researchers and business. The proposed framework of the market monitoring system shows the main activities and data sources that are necessary for a successful development of such a platform. It is important to note that a market trend monitoring system alone is not enough; a research centre should be also developed, the goal of which would be to further develop the methodological aspects of the analysis.

Lastly, a case example of Lithuanian regional indicator clusterisation has been provided. An

interesting trend was recognized in applying the clustering algorithm for a regional comparison. It was indicated that three clusters had a direct effect in comparing population size with the revenue of companies; however, the opposite effect was shown in one cluster. The identified clusters represent larger industrial regions of Lithuania, thus a deeper analysis of precise industries and infrastructure comparison should be conducted to provide recommendations for development within other regions. The case study indicated the importance of a market trend monitoring system for the regional development recommendations.

One limitation of the present research is that it focuses more on general economic development rather than on one specific problem. However, due to this factor the paper proposes a more general methodological approach to analyse various problematic areas. Another limitation of the research is that it focuses only on one country, and as such cannot compare trends between countries. The results stand as a general market monitoring framework.

In the future, the authors of the research are planning to use the data from Lithuania to develop an agent-based model to improve policy recommendations in a region to simulate the growth of an urban area. Other research initiatives could help integrate mathematical approaches to evidence-based policy. For example, more novel clustering algorithms might be developed which would create the possibilities of obtaining more insights as well as user-friendly interpretability of the results. The research has been funded by UAB "Lituka" ir Ko." However, the authors indicate that this vision of a market monitoring system could be proposed for global application and not limited only to one particular company.

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