ECONOMICS & Sociology

Tvaronaviciene, M., & Burinskas, A. (2020). Industry 4.0 Significance to competition and the EU competition policy. *Economics and Sociology*, *13*(3), 244-258. doi:10.14254/2071-789X.2020/13-3/15

INDUSTRY 4.0 SIGNIFICANCE TO COMPETITION AND THE EU COMPETITION POLICY: A LITERATURE REVIEW

Manuela Tvaronaviciene
Vilnius Gediminas Technical University,
Vilnius, Lithuania
E-mail:
manuela.tvaronaviciene@vgtu.lt
ORCID 0000-0002-9667-3730

Arunas Burinskas
Vilnius Gediminas Technical University,
Vilnius, Lithuania
E-mail:
burinskas.arunas@gmail.com
ORCID 0000-0001-6053-9495

Received: September, 2019
1st Revision: March, 2020
Accepted: June, 2020

DOI: 10.14254/2071-789X.2020/13-3/15

JEL Classification: D02, O17, P31

ABSTRACT. The coming fourth industrial revolution means many inevitable changes in firms' competition and the challenges they pose to industrial and competition policies. Therefore, to examine how it is going to affect competition and competition policy, this paper reviews the related literature of industrial policy, industrial organization and new trade theory. For this purpose, employing the semi-systematic review method, the report explores the theoretical background of the Industry 4.0 policy carried out by the EU, how it affects its competition policy and what threats it imposes to competition between firms. We have come to conclusions that the fourth industrial revolution might be quite challenging for the sustainability of firm's competition and the structure of industry and markets. However, the 'soft' EU industrial policy adequately addresses this problem by supporting SMEs with innovation and R&D to ensure sustainable competition in the long term.

Keywords: Industry 4.0, competition, EU competition policy, state aid, 'soft' industrial policy.

Introduction

Industry 4.0 is one of the industrial policy topics the importance of which for the EU economy is rapidly increasing. Although only around 1 in 10 firms in the EU is classified as manufacturing, the manufacturing sector accounts for 2 mln firms that generate 80% of the total exports and account for 80% of all private research and innovation funds. Industry 4.0 policy is, therefore, one of the critical elements of sustainable economic growth.

As the European Parliament has summarized, many observers believe that Europe is on the verge of a new industrial revolution called Industry 4.0. It is thought that this industrial revolution, combined with cyber-physical systems, network communications, simulation, big data and artificial intelligence technologies, will increase the flexibility of production, mass

adaptability of products by consumers, and will also increase the speed of their service, improve the quality of products and significantly increase productivity.

However, all the advantages of Industry 4.0 at the same time mean many inevitable changes and challenges they pose. One such problem concerns unavoidable changes in the competition and standard business models of many companies. According to a 2016 study by the European Parliament's Policy Department, Industry 4.0 is expected to revolutionize the business model of the industrial sector, i.e., companies will move from classical competition to qualitatively new competition based on: (i) innovation (the ability to deliver new products quickly); (ii) the ability to produce customer-friendly designs (through flexible and rapidly configurable plants); (iii) reducing equipment failures with increasing automation and control of processes.

All these coming challenges raise questions about the need for a new industrial policy; how it needs to be targeted to successfully address the challenges posed by the emerging business and competition model within the industrial production sector. Therefore, when planning industrial policy measures and their necessity, it is vital to anticipate how competition between companies, competitive behaviour triggered by Industry 4.0 will change. Therefore, this paper examines how the coming fourth industrial revolution and Industry 4.0 policy is going to affect competition and competition policy. For this purpose, the report explores the theoretical background behind Industry 4.0 policy carried out by the EU, how it affects its competition policy and competition between firms themselves. In the end, we have come to the main conclusions that (i) the coming fourth industrial revolution might be challenging for sustainability of firms competition; and (ii) the soft EU industrial policy adequately addresses this problem by supporting SMEs with innovation and R&D to ensure sustainable competition in the long term.

1. Method

For detecting possible implications of the Industry 4.0 revolution to competition and competition policy, we employ the semi-systematic review method (or narrative review approach) which is designed for reviewing different disciplines studied by different groups of researches (Wong et al., 2013).

Having an immense amount of studies in each discipline: industrial policy, industrial organization and new trade theory, to review all papers in each of them is simply not possible. In time, all these disciplines have been progressing very differently, and their contribution to the notion of competition and competition policy is unique. Therefore, we have chosen to identify and understand all potentially relevant research traditions and their implications to our topic, aiming to synthesize them with meta-narratives. Overall, in our literature review, we have selected 44 papers in total.

To achieve a transparent research process, we have developed a strategy to assess whether our arguments for the judgements made were appropriate from both a methodological perspective and from the perspective of the selected topic.

To identify, analyze and report patterns, we used a content analysis technique that is followed by qualitative analysis. The design of our review follows chronological emergence of ideas, notion, and theories in the mentioned disciplines. Besides, we track how the development of industrial organization followed by the new approach of new trade theory (that emerged at the very beginning of this century) affected industrial policy, particularly, in the European Union.

2. Literature review

2.1. Industry 4.0 and its place in the debate on the most appropriate industrial policy

The Industry 4.0 policy undoubtedly attracts attention to an industry increasingly. According to Bloem et al. (2014) and Hermann et al. (2016), this term has emerged in Germany following the adoption of an industrial policy program called "Industry 4.0", which is a part of the 'High-Tech Strategy for Germany 2020'. Besides, in 2015, the European Commission initiated the CREMA research program to encourage investment in Industry 4.0 (as part of Horizon 2020).

Rüßmann (2015) reveals the projected importance of the Industry 4.0 program for German industry: productivity growth in all German industrial sectors is expected to increase from 90 to 150 billion Euros, which would represent an increase of 5-8 % (but in individual industries it can reach as much as 10-20 %); German producers' revenues are expected to grow by around €30 billion (or - about 1% of Germany's GDP) each year; labour demand will increase by 6%, and investment is expected to increase by around EUR 250 billion over the next ten years.

Heng et al. (2014) highlight the potential importance of the fourth industrial revolution on a global scale, with the projected robust growth in global GDP (see Figure 1).

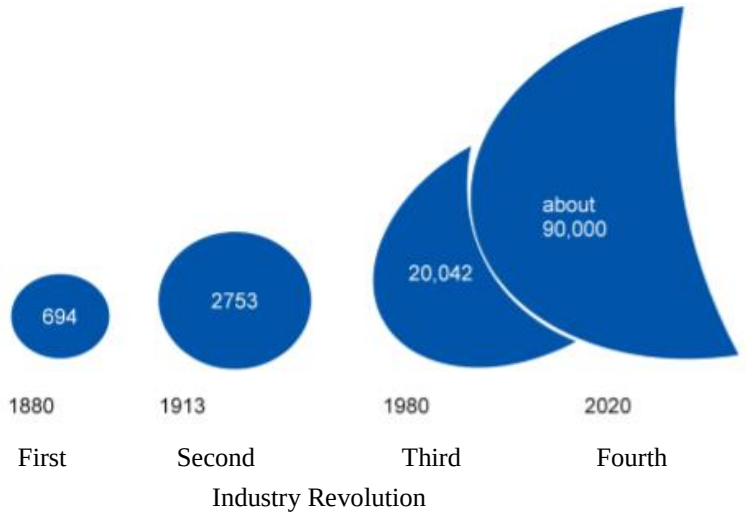

Figure 1. Global GDP growth, billions of US dollars (purchasing power recalculated)
Source: Heng et al. (2014)

Although the definition of the fourth industrial revolution is not settled, it is linked to the integration of information and operational technologies leading to cyber-physical systems, the creation of 'smart factories' and the internet of things (IoT). Cyber-physical systems can be of three kinds: M2M ("machine-machine" communication), forecasted machine maintenance and M2C ("machine for users" communication). The first one allows to automate communication between machines; the second one allows predicting the depreciation of machinery and their parts and the necessary replacement, and the third one allows to increase the added value of goods or services.

The question of what kind industrial policy the Industry 4.0 might be cannot be answered unequivocally. Until now, there is no consensus in the scientific literature on the definition, conception and meaning of industrial policy in general. There is disagreement as to the scope of the objectives and measures attributable to it.

This may be caused by mixed results of industrial policy in different countries and at various times. In some states, it was successful: after the Second World War in western European countries, and later in Japan, South Korea and other countries, interventionist policies resulted into the new industrial structures of those countries with large, strong and advanced firms. In a different time, some countries (e.g. France being already in European Economic Community (EEC)) were implementing the interventionist industrial policy and ended up with failure: with distortions of competition and weak, technologically backward firms that exploited economic rents created by such policies Pack et al. (2006).

For this reason, in the early 1990s, interventional industrial policy was formally abandoned in many countries (primarily the European Union (EU)). It was considered sufficient to maintain free competition in the markets, which would solve everything. However, such policy did not bring desirable results – EU gave up leading positions in R&D activity for such countries as the USA, South Korea, Japan. Therefore, at the beginning of this century, industrial policy has been 'remembered' and revived as a compromise between industrial and competition policies.

The definitions of the industrial policy below reflect this development of industrial policy (summarized in Table 1), which has resulted in individual industrial policies.

Table 1. The types of industrial policy

Industrial policy types	Key objectives	Changing structures	Corporate discrimination	Protection of competition	Countries that applied it
Soft industrial policy					
Horizontal	*Status Quo* (markets will fix everything themselves)	No	No	Yes	Germany within the EU; EU
New (Modern)	Promoting economic growth and technological progress	Indirectly initiates the emergence of new structures through the promotion of R&D	Partially (only if the conditions are fulfilled)	Yes	USA, EU (after 2004)
Intervention industrial policy					
Soft interventions	Promoting economic growth and technological progress	The creation of new structures without directly changing present ones	Yes	Partially (creating more active competition in the future)	Japan, South Korea, China
Direct interventions	The creation of national champions; national security; strategic energy projects; social objectives	Modification of existing market structures	Yes (chose of champions)	No	Western European countries after World War II; France, Spain, Italy in the EU until 1986-90; China; some measures acceptable as extremely exceptional policy in many countries (including EU members)

The need for an interventionist industrial policy is based on the theory of market failures, according to which markets are not perfect and corrective interventions are necessary. The definitions of interventionist industrial policy emphasize the evolution of the structure of the industry. Pack et al. (2006) see the industrial policy as any selective intervention or policy of government institutions aimed at changing the production structure in such a way as to create better prospects for economic growth.

Meanwhile, the characteristics of a soft intervention industrial policy can be seen in Warwick (2012) industrial policy definition, according to which industrial policy is a set of measures aimed at improving the business environment or changing the structure of economic activity in such a way as to create industries, technologies or tasks that will enhance the prospects of economic growth and public welfare without substantially damaging competition (at least in the medium or long term).

Summarizing examples of successful industrial policy, Cimoli et al. (2015) points out that the essential elements of industrial policy should be (i) the protection (from the competition and intellectual property rights) of emerging or still-developing enterprises (often small at the beginning) in short to medium term, (ii) regulation of economic rents received by firms and (iii) macro-economic policies that promote the industry as a whole. The emphasis is placed on the temporary protection afforded to growing enterprises against competition from more technologically advanced and larger firms, in particular foreign exporters, which would generally stimulate competition in the medium to long term.

At the same time, however, it is stressed that these measures must be combined with the maintenance of competition between the protected undertakings themselves and their encouragement to compete in export markets. Cimoli et al. (2015) note that in the 20th century, after World War II, this industrial policy was successfully applied by the USA, Britain, Germany, France, Japan, South Korea, the African Republic, Taiwan and China. However, much more radical industrial policy seems more appropriate and acceptable only to developing countries.

Meanwhile, as Foster-McGregor et al. (2013) point out that US and EU (in recent decades) have been enjoying so-called 'soft' industrial policy (in EU, also known as modern (or new) industrial policy).

The 'soft' (or modern) industrial policy is probably most accurately characterized by the concept of industrial policy proposed by Aghion (2012), according to which it covers all measures taken by government authorities to 'adequately address the failures of a particular market', without, in principle, violating the established protection of competition. This presupposes that a 'modern' industrial policy may even include interventions if strict conditions for the protection of competition are met (see Table 2).

Advocates of this industrial policy emphasis, in particular, on dynamic efficiency as a critical value and objective of industrial policy. Here is the concept of industrial policy proposed by Foster-McGregor et al. (2013) that defines industrial policy as a set of measures aimed at promoting economic growth, both quantitatively and qualitatively, which should materialize to changes in the structure of the economy. Such effects may be triggered by the design of economic activities or industries; and by determining the direction of technological progress; and also, by influencing the distribution of enterprises and plants according to their performance indicators (Prause, Atari, 2017; Dzwigol et al., 2020).

Under the proposed notation of modern industrial policy, in addition to promoting economic growth, industrial policy can also focus on protecting the most critical national interests in the fields of energy and defence (Kiseľáková et al., 2018; Tvaronavičienė, Ślusarczyk, 2019; Plėta et al., 2020).

All these notations contradict with the position of those who argue that the best industrial policy is competition policy itself only. This short definition reflects the period of development in the EU when the industrial policy was generally negative, and only horizontal measures were applied.

In the current period, horizontal industrial policy in the EU (together with Industry 4.0) remains as a significant part of a new (modern) industrial policy, which emphasizes the adequate application of any measures. This is apparent from Table 2, which sets out the industrial policy measures attributable to different types of industrial policy.

Overall, the definitions and concepts provided for industrial policy show that Industry 4.0 policy in EU is strongly influenced by the objectives set to it and by the combinations of the measures chosen to achieve them. Actually, in the EU, Industry 4.0 goes as an exemption from State Aide rules of competition policy.

Table 2. The main measures of industrial policy

Industrial policy measures		Industrial policy			
		Intervention	Soft interventions	New (Modern)	Horizontal
Direct intervention measures	Champion selection	X		x*	
	Business mergers	X		x*	
	Unnatural monopolies	X			
	Administrative measures for the management of competition		X		
State aid measures (for selected enterprises)	Grants, grants	X	X	x*	
	Remunerable and non-remunerable loans, guarantees	X	X	x*	
	Administrative, non-tariff barriers for non-privileged enterprises	X	X	X	
	Other State aid measures compatible with the protection of competition (under joint programs)			X	
Public procurement to support demand			X	X	
Industry 4.0 in EU: A competition law (state aid) exemption for SMEs				X	X
Horizontal (indirect) measures	Programs to promote cooperation between enterprises, scientific bodies in R&D and innovation activities		X	X	X
	Education programs, including enterprises		X	X	X
	All other general programs (promoting ecology, energy, small and medium-sized enterprises)			X	X

x – in exceptional cases*

As a rule, the necessity of specific measures in individual cases should be determined by a particular competition between firms and the structure of markets or industries in a specific macroeconomic environment. However, in the case of Industry 4.0 in the EU, it has to comply with horizontal measures without any possible and not grounded with national interests' discrimination.

2.2. The change in the concept of competition paradigm that has led to Industry 4.0 as a 'soft' industrial policy

Bianchi et al. (2006) point out that interventionist industrial policy is characterized by (i) protection of developing industries (import barriers, subsidies, etc.); (ii) export support (subsidies, awards from exporting companies...); (iii) nationalization; (iv) support for large enterprises (initiation, promotion of mergers and acquisitions, artificial increase in the market share of the selected firm); (v) orientation towards the management of protected enterprises; (vi) attracting foreign direct investment (tax concessions, subsidies and other incentives).

Such an interventionist policy has a theoretical basis. It was based on the SCP paradigm (the structure of the industry; conduct and performance of a firm). In the beginning, it was interpreted as, if the concentration of the market determines the size, profitability and efficiency of the firms, the interventions could lead to the creation of large undertakings (or simply national champions), and the positive consequences should result from such modification of the industrial structure. This model, therefore, makes two fundamental assumptions: (i) there are a stable interaction and causation that starts with the structure and manifests itself through corporate behaviour towards enterprise performance indicators; (ii) the parameters of the market power of undertakings may be calculated using the available data. Accounting data may be used to approximate the Lerner index or economic gains.

The basic idea of the SCP paradigm is clear: it aims for establishing links between the industrial structure and the performance indicators of enterprises, which are specific to all or part of the industry.

In time, there has also been criticism of the SCP paradigm and the policy measures it proposes. Church et al. (2000) state that the observed positive correlation between market concentration and the profitability of undertakings does not necessarily indicate undertakings with greater market power (in other words, the equation in question may have reservations). According to them, any company can be more profitable because its marginal costs are lower, which allows it to sell more and generate higher profits in the event of a decline in the number of competitors. Therefore, higher profitability in higher concentration industries is not necessarily due to increased market power for companies. Larger, more efficient companies in industries receive Ricardian economic rents as economic gains since alternative costs of the source of efficiency advantage are not included in their costs. According to this interpretation, the increase in concentration in the industry should be attributed only to the rise in profitability of large and not small enterprises.

Moreover, the Lerner index of the oligopolistic company correlates with market share and not with market concentration. The positive correlation between profitability and market share is also well in line with the acquisition of market power in the oligopoly. Therefore, the SCP paradigm probably wrongly assumes causation (Church et al., 2000). Its central hypothesis refers to the variables of concentration and entry barriers as to exogenous hat have nothing to do with profitability. However, it is highly doubtful that it is the case. Firstly, in the oligopoly, we expect market shares and the acquired market power to be endogenously addressed by the number of activities, costs and competing companies. Concentration is endogenous, as is (to a specific limit) entry barrier. Also, the parameters of the entry barriers reflecting the behaviour of the company are endogenous (the intensity of advertising is a vivid example of this).

In general, it can be expected that there is a reciprocal link: the behaviour of the company today affects the concentration of tomorrow's companies, their size and profitability that subsequently influences their behaviour. The assessment of the relationship between the positive concentration, the correlation between entry barriers and market power, even though profitability, concentration and entry barriers can be addressed in the past, means that the

establishment of a positive correlation relationship in question will be tendentious. The SCP paradigm can, therefore, be interpreted as a cycle (see Figure 2). The base conditions showed in the SCP paradigm interpretation diagram are proposed by Carlton et al. (2000). They divided them into two groups: (i) consumer demand factors (elasticity of demand, substitutes, seasonality, rate of economic growth, place of business, orders management, organization of purchases); (ii) factors of production (technology, production resources, mergers, product durability, place of business, economies of scale and scope).

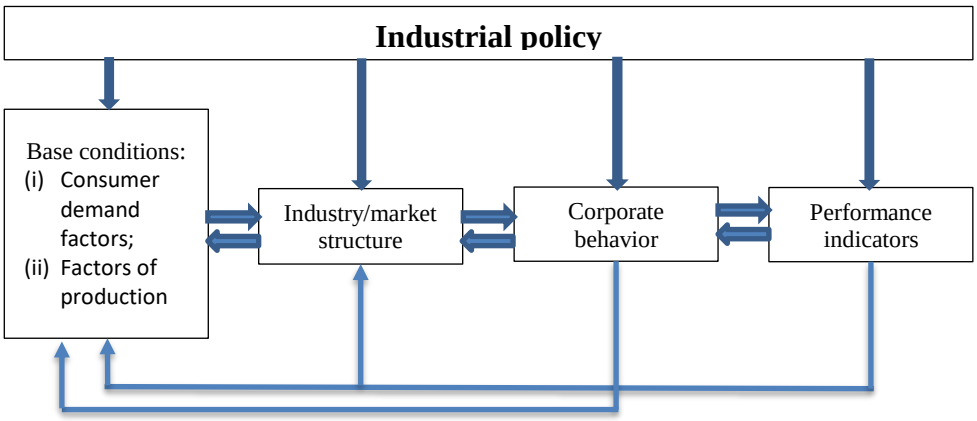

Figure 2. SCP paradigm interpretation diagram

Barthwal (2007) states that, besides mentioned base conditions, the structure of the market depends not only on the concentration of undertakings and the conditions of entry to the market but also on the degree of goods differentiation.

The interpretation proposed by the SCP paradigm critics asserts that it is the structure of the market which depends on many conditions, namely, not only on the efficient use of resources and firms strategic behaviour but also on investments in R&D and its results, i.e. on dynamic efficiency. At the same time, however, enterprises must adjust their strategies, innovation and R&D activities responding to the current market (or industry) structure, which shows how resources are distributed among the rivals (Tung et al., 2010; Bednář & Halásková, 2018).

Besides, over time, economists such as J. Stiglitz (a recipient of the Nobel Memorial Prize in Economic Sciences (2001)) and others have begun to prioritize soft-intervention industrial policies for several reasons (Cimoli et al., 2015).

Firstly, economies of scale, although a significant factor in the competition between companies is not the most important or not the only one among the most significant causes of firms' growth. Products differentiation, including brands; introduction of new technologies and innovations, usually resulted in lower marginal costs and higher quality of products, can determine the outcome of a competitive struggle between undertakings. This contrast was particularly evident in France in the 1970s and 1980s, when, according to Perrot (2010), demand for a large proportion of the country's artificially developed national champions' goods steadily declined due to competition of more innovative, and more technologically advanced rivals from Germany and other countries. The constant updating of existing products and the emergence of new ones offered by foreign competitors have often seemed more attractive to French consumers.

Secondly, a high concentration of markets can even be a significant obstacle to dynamic efficiency. The largest and once efficient former companies, which have acquired considerable market power, may lose, in whole or part, incentives to continue investing in R&D and innovative activities. Meanwhile, other competitors may not have sufficient capacity, skills, knowledge, and technology to successfully compete with market leaders that have accumulated the highest market demand.

Often R&D activity and demand accumulation are long-term and costly processes whose funding is affordable for the pocket of the largest companies. Legal barriers, such as the protection of intellectual property, are also of great importance.

The practical examples of Japan, South Korea and the USA have clearly shown that the protection of local small and medium enterprises (SMEs) against competition from large local and foreign firms, the artificial maintenance of demand for SMEs' goods and services (government procurement) while maintaining fierce competition between them, i.e. allowing to withdraw from the competitive struggle, makes it reasonable expecting long-term and sustainable growth.

For all these named reasons, as Cimoli et al. (2015) observes, over the last decade, the emphasis was placed on the industrial policy that employs soft interventions only.

Therefore, examples of successful soft interventions in industrial policy reveal how the management of competition in the industry, through intervention, replaces these signals in such a way that they re-promote dynamic efficiency. According to Cimoli et al. (2015), soft industrial policy is characterized by success with the following features:

- The emphasis on the central role of public sector bodies such as universities in implementing new technological paradigms.
- Secondly (and this concerns the first point too), only good intentions are often not enough. It is the firm's capacity and its extension that plays a crucial role in industrial and innovation policies.
- Thirdly, market discipline (maintaining competition) is useful as long as it helps to 'rein in' companies that are lagging behind and thus rewards leading ones.
- Fourthly, mechanisms to curb the inertia of protected enterprises and their pursuit of economic rents are applied.
- The industrial policy successful in *catching up* with income per capita and wage growth is always combined with the introduction of new and dynamic technological paradigms, regardless of the initial competitive advantage, specialization, or market-generated signals.

For all these reasons, a soft interventionist industrial policy sometimes is referred to as 'catch up' policy: it aims to strengthen the position of protected enterprises in markets by investing in R&D activities to reduce the prices of goods due to increased productivity (Bianchi et al., 2006). Also, it seeks to improve and exploit existing production capacity (Ajami et al., 2006), allowing for the expectation of successful exports (Yoffie, 1993); governments, through a wide range of fiscal stimulus, promote R&D and innovation, skills and exports together with strict protection of internal competition to the extent that international commitments do not prohibit (Quack et al., 2000; Mehta, 2006). Meanwhile, soft intervention industrial policy partly finds adaptation to the promotion of small and medium-sized enterprises (SMEs) by focusing only on markets of production factors: R&D activities, workforce training, access to financial resources and infrastructure (Warwick, 2013; Bilan et al., 2019).

2.3. Expected and potential impact of Industry 4.0 on competition (the new trade theory approach)

As already mentioned, the measures implemented under Industry 4.0 policy should significantly reduce the marginal costs of enterprises and increase their added value. What this might mean for firms' competition can be intuitively predicted by analyzing the literature of the empirical industrial organization and the new trade theories.

The firms are heterogeneous in terms of productivity, so their decisions to sell abroad and even market shares depend on their productivity level: only higher productivity companies can invest in expensive exports or even more costly foreign direct investment (FDI) activities (Melitz, 2003; Helpman et al., 2003; Korshenkov, Ignatyev, 2020).

Bernard et al. (2006) and Melitz (2008) observe that only a small proportion of all companies operating on the market or in the industry as a whole are engaged in export activities, that would generate a significant share of their gross income. In most cases, such undertakings are larger and more productive than companies which do not export at all.

Intuitively, it could be assumed that, if the largest companies are the most productive, the prices of their goods should also be the lowest. However, empirical studies show that the opposite is true. Schott (2004) revealed that in narrowly defined markets, companies operating in high-income countries abundant with capital and knowledge export at relatively higher prices.

Productive companies produce more attractive products for consumers. Also, the value of the product is influenced by vertical product differentiation (Gervais, 2013). Productive larger companies produce and sell higher quality products. Also, even small but high-quality companies can successfully export. The quality of companies' products correlates with the intensity of the company's investments, operating costs of R&D, product and technological process innovations and the cost of obtaining quality standard certificates. The evidence got shows that more efficient companies sell more high-quality products, covering more markets (Duvaleix-Tréguer et al., 2015; Wichitsathian, Nakruang, 2019).

High-quality and high-priced goods are the most competitive– their exports can cover the highest trade costs associated with their long transport distances (Baldwin et al., 2009; Johnson, 2012).

Besides, increased productivity of companies also allows them to produce and sell a broader range of assortment. Still, as competition between companies intensifies, they abandon the production of the least profitable products (Mayer et al., 2011).

Although it might seem that only the large companies can be more productive and create additive value, it is not their size, but competitive pressure that leads to the growth of firms' productivity (Melitz et al., 2008). The size of the undertakings is only a consequence of it. To remain competitive and be able to engage in exporting or FDI activities, companies do not have to be large – they must be effective (Baldwin et al., 2014; Prodani et al. 2019; Orynbassarova et al., 2019).

3. The main take-aways and discussion

The Industry 4.0 revolution can undoubtedly open up new opportunities for businesses to become more efficient, modernize internal processes and develop innovative products, increasing quality and delivery times. Although the Industry 4.0 agenda looks very attractive, it requires enormous investment, organizational changes that are impossible without staff development. This, therefore, implies a growing need to strengthen workers' skills and knowledge.

Also, in the context of globalization, the high-tech research sector might be lagging behind these emerging challenges at the global or regional level (Stavytskyy et al., 2019). As, by the way, small and medium-sized enterprises (SMEs). This is mainly true of traditional sectors.

Therefore, countries and their industrial policy designers may have reasonable doubts as to how competition between undertakings and the structure of industry or markets will be affected by Industry 4.0 in the absence of support for small and medium-sized enterprises (SMEs) and, more generally, research activities. Answers to these questions can be found in the industrial organization and other scientific literature related to industrial policy.

In the European Union, the Industry 4.0 policy is a mix of 'soft' industrial and horizontal policy measures. Apparently, in its nature, it is closest to the industrial policies carried out in South Korea and Japan. It provides the government's support for SMEs that follows the non-discrimination principle and competition policy rules which should hinder the accumulation of Ricardian economic rents. Such policy design aims at changes in both the structure of the economy and firms technological progress.

This kind of 'soft' industrial policy targets not an artificial restructuring of industry, but the promotion of economic growth increasing dynamic efficiency therein. The approach to the meaning of industry (or market) structure has changed drastically: now it is seen not as a factor that determines the size, efficiency and profitability of enterprises, but rather as a feature that demotivates large undertakings to engage in R&D activities (due to their obtained market power) or an obstacle for SMEs to invest in such activities. Markets with high concentration and market power of leading companies distort market signals in such a way that there are no reasons for dynamic efficiency to grow.

The Industry 4.0 policy follows the most modern approach of soft interventions in the industry. This approach is characterized by (i) scientific and technological research programs (promoting research in universities, granting subsidies for and organization of cooperation in R&D activities, including direct links between enterprises and research institutions); (ii) promoting the development of high and medium-level skills (promoting learning and education in the second profession); (iii) strategic support for the industry, i.e. promoting future technology development in the industry, supporting relevant R&D programs.

These measures of 'soft' industrial policy find support in the new trade theory that stresses the firm's heterogeneity in terms of their productivity indicators. Higher productivity allows companies to invest more not only in the quality of goods but also in the development of their assortment. In other words, more productive companies can invest more in product differentiation.

In general, productivity can have a compensatory effect on prices. On the one hand, higher productivity lowers prices by reducing marginal production costs. However, on the other hand, higher productivity allows the company to improve the quality of products, which increases marginal costs and prices. Whether high-productivity companies set higher or lower prices than lower productivity companies depends on the company's incentives to improve the quality of products. Companies decide on export opportunities when they choose whether to improve the quality of products.

All the evidence, as mentioned earlier of competition between undertakings, reveal the possible influence of present digitalization process and the role of Industry 4.0 policy. It can be foreseen that, having in their disposition significant financial and other resources, large enterprises have more excellent opportunities and a higher probability of achieving dynamic efficiency faster. Without additional support and incentives to invest in business digitization, SMEs will soon lose the competitive battle. If SMEs fell out of competition, the remaining large

companies could increase their margins and prices; as a result, collecting Ricardian economic rents, thus losing incentives to innovate, i.e. further increasing dynamic efficiency.

Therefore, the support for SMEs carried out in the context Industry 4.0 policy, although at the core may be considered as the soft intervention, has strong economic justification for exemption from State Aid rules. The horizontal support provided for SMEs business digitization, innovation, and R&D will assist competition despite soft intervention with direct state aid. Therefore, it allows us to anticipate sustainable competition and increased dynamic efficiency in the long term.

Conclusion

While many believe that Europe is on the verge of a new industrial revolution called Industry 4.0, this paper addresses the problem of the place of industrial policy called of the same name in the hierarchy of all industrial policies, including relations with competition policy.

In the light of all industrial policies pursued so far, the EU's 'soft' industrial policy – Industry 4.0 – cautiously covers the best measures that took place in different countries and at various times. Despite the EU abandoning industrial policy in the 1990s, a "soft" industrial policy was introduced at the beginning of this century. Now the EU *de facto* pursues a broad interventionist policy by providing state aid to SMEs, with an exemption from State Aid rules, thus significantly adapting its competition policy. However, the competition itself is ensured through this support alignment following the traditions of horizontal policy, i.e. in strict compliance with one of the fundamental principles of non-discrimination in the EU (in this case – among SMEs).

This choice for the EU is in line with the simultaneous changes at the theoretical level of the competition paradigm. It is now almost indisputable that it is not the size and market power of the company that has a positive impact on its ability to compete, but the so-called 'base' characteristics, such as productivity, product quality, and others that in the long run determine the growth of companies and the ability to compete successfully on the market.

This is confirmed by numerous theoretical works and empirical studies carried out by representatives of the empirical industrial organization and the new trade theories. They also reveal the potential risks of the fourth industrial revolution: large companies have a clear advantage over SMEs, with abundant resources at their disposal. Thus they can reap the essential benefits of digitizing the business more quickly and driving the remaining competitors out of the market. It is therefore justified to consider that the 'soft' EU industrial policy is appropriately targeting the solution to this problem by supporting SMEs with innovation and R&D to ensure sustainable competition in the long term.

Acknowledgement

This project has received funding from the European Regional Development Fund (project No 09.3.3-LMT-K-712-19-0037) under a grant agreement with the Research Council of Lithuania (LMTLT).

References

Aghion P. (2012). Growth Policy and the State: Implications for the Design of a European Growth Package. *Note for LSE Growth Commission, London, LSE* (2012).

Ajami R. A., Cool K., Goddard G. J., & Khambata D. (2006). International business – theory and practice. M. E. Sharpe.

Baldwin R. E., & Okubo T. (2014). International trade, offshoring and heterogeneous firms. *Review of International Economics*, 22(1), 59-72.

Baldwin, R., & Harrigan, J. (2011). Zeros, quality, and space: Trade theory and trade evidence. *American Economic Journal: Microeconomics*, 3(2), 60-88.

Barthwal R. R. (2007). Industrial Economics: An Introductory Text Book. New Age International.

Bednář, P., & Halásková, M. (2018). Innovation performance and R&D expenditures in Western European regions: Divergence or convergence? *Journal of International Studies*, 11(1), 210-224. doi:10.14254/2071-8330.2018/11-1/16

Bernard, A. B., Jensen, J. B., Redding, S. J., & Schott, P. K. (2007). Firms in international trade. *Journal of Economic perspectives*, 21(3), 105-130.

Bianchi P., & Sandrine L. (2006). Empirical evidence on industrial policy using state aid data. *International Review of Applied Economics*, 20(5), 603-621.

Bilan, Y., Rubanov, P., Vasylieva, T., & Lyeonov, S. (2019). The influence of industry 4.0 on financial services: Determinants of alternative finance development. *Polish Journal of Management Studies*, 19(1), 70-93.

Bloem, J., Van Doorn, M., Duivestein, S., Excoffier, D., Maas, R., & Van Ommeren, E. (2014). The fourth industrial revolution. *Things Tighten*, 8, 11-15.

Carlton D. W., & Perloff J. M. (2000). Modern Industrial Organization. 3rd edition. Boston: *Addison Wesley*.

Church, J. R., & Ware, R. (2000). Industrial organization: a strategic approach (pp. 367-69). *Homewood*, IL.: Irwin McGraw Hill.

Cimoli M., Dosi G., & Stiglitz J. (2015). The Rationale for Industrial and Innovation Policy. *Revista do Serviço Público*, 66, 55-68.

Duvaleix-Treguer, S., Emlinger, C., Gaigné, C., & Latouche, K. (2015). Quality and export performance evidence from cheese industry (No. 714-2016-48611, pp. 1-11).

Dzwigol, H., Dzwigol-Barosz, M., Miskiewicz, R., & Kwilinski, A. (2020). Manager competency assessment model in the conditions of industry 4.0. *Entrepreneurship and Sustainability Issues*, 7(4), 2630-2644. http://doi.org/10.9770/jesi.2020.7.4(5)

Foster-McGregor, N., Holzner, M., Landesmann, M., Pöschl, J., Stehrer, R., & Stöllinger, R. (2013). A'Manufacturing Imperative' in the EU–Europe's Position in Global Manufacturing and the Role of Industrial Policy (No. 391). wiiw Research Report.

Gervais A. (2013). Product quality and firm heterogeneity in international trade. *US Census Bureau Center for Economic Studies Paper*, Nr. CES-WP-13-08.

Helpman E., Melitz M. J., & Yeaple S. R. (2003). Export versus FDI. *National Bureau of Economic Research*, Nr. w9439.

Heng, S., Slomka, L., Ag, D. B., & Hoffmann, R. (2014). Industry 4.0. Upgrading of Germany's industrial capabilities on the horizon, Frankfurt am Main: Deutsche Bank Research.

Hermann, M., Pentek, T., & Otto, B. (2016). Design Principles for Industrie 4.0 Scenarios. In *2016 49th Hawaii International Conference on System Sciences (HICSS)* (pp. 3928-3937). IEEE.

Johnson, R. C. (2012). Trade and prices with heterogeneous firms. *Journal of International Economics*, 86(1), 43-56.

Kiseľáková, D., Šofranková, B., Čabinová, V., & Onuferová, E. (2018). Competitiveness and sustainable growth analysis of the EU countries with the use of Global Indexes' methodology, *Entrepreneurship and Sustainability Issues*, 5(3), 581-599. http://doi.org/10.9770/jesi.2018.5.3(13)

Korshenkov, E., & Ignatyev, S. (2020). Empirical interpretation and measurement of the productivity and efficiency of regions: The case of Latvia. *Insights into Regional Development*, 2(2), 549-561.

Mayer, T., Melitz, M. J., & Ottaviano, G. I. (2014). Market size, competition, and the product mix of exporters. *American Economic Review*, 104(2), 495-536.

Mazzoni, F. (2020). Circular economy and eco-innovation in Italian industrial clusters. Best practices from Prato textile cluster. *Insights into Regional Development*, 2(3), 661-676. https://doi.org/10.9770/IRD.2020.2.3(4)

Mehta, P. S. (2006). A functional competition policy for India. *Academic Foundation*, 294 p.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71,1695-1725.

Melitz, M. J. (2008). International trade and heterogeneous firms. *The New Palgrave Dictionary of Economics*, 2.

Melitz, M. J., & Ottaviano G. I. P. (2008). Market Size, Trade, and Productivity. *The Review of Economic Studies*, 75, 295-316.

Orynbassarova, Y., Abzalbek, E., Pritvorova, T., & Petrenko, Y. (2019). Regional and product profile of post-industrial services in the economy of Kazakhstan. *Insights into Regional Development*, 1(4), 343-355. https://doi.org/10.9770/ird.2019.1.4(5)

Pack H., & Saggi K. (2006). Is there a case for industrial policy? A critical survey. *The World Bank Research Observer*, 21(2), 267-297.

Perrot, A. (2010). 18. Do national champions have anything to do with economics?. Competition Law and Economics: Advances in Competition Policy Enforcement in the EU and North America, 293.

Plėta, T., Tvaronavičienė, M., Della Casa, S., & Agafonov, K. (2020). Cyber-attacks to critical energy infrastructure and management issues: overview of selected cases. *Insights into Regional Development*, 2(3), 703-715. https://doi.org/10.9770/IRD.2020.2.3(7)

Prause, G., & Atari, S. (2017). 0n sustainable production networks for Industry 4. *Entrepreneurship and Sustainability Issues*, 4(4), 421-431. http://doi.org/10.9770/jesi.2017.4.4(2)

Prodani, R., Bushati, J., & Andersons, A. (2019). An assessment of impact of information and communication technology in enterprızes of Korça region. *Insights into Regional Developmen*t, 1(4), 333-342. https://doi.org/10.9770/ird.2019.1.4(4)

Quack S., Morgan G., & Whitley R. (2000). National capitalisms, global competition, and economic performance. *John Benjamins Publishing Company*, 322 p.

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). Industry 4.0: The future of productivity and growth in manufacturing industries. *Boston Consulting Group*, 9(1), 54-89.

Schott, P. K. (2004). Across-product versus within-product specialization in international trade. *The Quarterly Journal of Economics*, 2, 647-678.

Stavytskyy, A., Kharlamova, G., Giedraitis, V., & Sengul, E. C. (2019). Gravity model analysis of globalization process in transition economies. *Journal of International Studies*, 12(2), 322-341. doi:10.14254/2071-8330.2019/12-2/21.

Tung G. S., Lin, C. Y., & Wang C. Y. (2010). The market structure, conduct and performance paradigm re-applied to the international tourist hotel industry. *African Journal of Business Managemen*t, *4*(6),1116-1125.

Tvaronavičienė, M., & Ślusarczyk, B. (2019). Energy transformation towards sustainability. Energy transformation towards sustainability (pp. 1-333). doi:10.1016/C2018-0-02510-4

Warwick K. (2012). Beyond Industrial Policy. Emerging issues and new trends. *OECD Science, Technology and Industry Policy Papers*, Nr. 2.

Warwick K. (2013). Beyond Industrial Policy: Emerging Issues and New Trends. *OECD Publishing*, Nr. 2.

Wichitsathian, S., & Nakruang, D. (2019). Knowledge integration capability and entrepreneurial orientation: case of Pakthongchai Silk Groups Residing. *Entrepreneurship and Sustainability Issues*, 7(2), 977-989. http://doi.org/10.9770/jesi.2019.7.2(13)

Yoffie, D. B. (1993). Beyond free trade – firms, governments, and global competition. *Harvard Business Press*, 466 p.