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THE USE OF THE GRAPH THEORY TO INVESTIGATE THE ROLE OF THE ECONOMIC INTELLIGENCE FOR THE NATIONAL SECURITY

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The present article provides a complete and comprehensive analysis of the significance of the Economic Intelligence as an instrument to pursue the national interest and to guarantee the national security. The Wesfalian approach and its social-economic connotation to interpretation of the national interest have been analyzed. The economic aspect of national interest has been highlighted, as well as its gaining the momentum in the definition of national security has been underlined. For that to be done, by using the mathematical approach deriving from the graph theory, three different innovative models are presented. Those models are based on dissimilar economic levels of abstraction analysis, which represent a scientific logic description of the different Economic Intelligence approaches offered by the academic literature on the basis of the reference object. At a first level of abstraction analysis the economic intelligence has been simply defined as the set of information of a purely economic nature. It has been underlined that the second level of abstraction instead requires the definition of more fixed points, able to represent the different components of a new dynamic conceptual scheme aimed to extrapolate a more articulated representation of the Economic Intelligence concept. In the specific, according to the more complex and articulated third level of abstraction analysis, the Economic Intelligence could be described as a system (subject to geometrical variance) of entities, structures, scientific methods and instruments of analysis interconnected by means a common shared language, aimed to manage flows of data and diversified information, in order to generate the best possible understanding of the object of analysis, useful for supporting policies and decisions. It has been proved that shared information circulating within the system has an informative content, and therefore a value, potentially superior to the same information when it is collected and analyzed. The implications for it have a double important practical impact, as they demonstrate the generation of synergies to the benefit of the whole system as well as an absence of determination of evolution of information, but only estimation with a probabilistic approach.

Keywords: economic intelligence, international relations, information asymmetry, knowledge, graph theory, national security.

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Introduction

The main aim of the Economic Intelligence (EI) is the search and the use of the information, in order to support the decision-maker in the more complex international relationships resulting from the globalization, the development of ICT, and the diffusion of the liberal economic principles. The role of the EI consists, in fact, in providing a country with the necessary knowledge to pursue the national interest and to guarantee the national security. Consequently, to better understand the real role of the EI in the new environment of the international relations' system it is necessary to have a clear idea about the actual meaning of national interest and national security. The locution national interest is generally used to describe the highest interest to which politics must subordinate every other interest [1, 481]. This is a generally vague meaning, which however represents the least common multiple of the numerous definitions in the literature on the

subject. Wanting to give a more concrete interpretation of the national interest, it is possible to refer to the Wesfalian approach, according to which the national interest is the sum of three fundamental elements: state sovereignty, independence, and territorial integrity. The protection and the ultimate defence of these essential elements, according to a Machiavellian reading that would make the national interest coincide with the raison d'ётat, justifies the use of any means, lawful or illicit, moral or immoral. But the protection of those values of sovereignty, integrity and independence just mentioned, elements that represent the foundations and the very essence of the whole state apparatus, is nothing more than the conceptual content of national security: content that thus overlaps with locution of national interest and raison d'ётat. Nonetheless, the above definition, of a Wesfalian imprinting, constitutes only a possible interpretation (the most restricted among the others) of the concept of national interest, which historically has also embraced social, economic and cultural aspects. In particular, in the United States, during the great depression, the impoverished population's demand for greater government attention to welfare policies, has given to the concept of national interest an social-economic connotation, expanding its significance with respect to historical Wesfalian approach. Thus, even though the definition of national security remained linked to the three fundamental elements of the whole state apparatus, the one of national interest started to embrace also features of the economic sphere. Subsequently, during the Cold War, the threats related to a possible external aggression by the countries of the Soviet bloc redefined the priorities of the community and redirected again the meaning of national interest towards the one of national security [1, 482], with a particular emphasis on the military aspect (the economic aspect returned to be absent in both the definition of national interest and in the one of national security). After the fall of the Berlin Wall, however, the transition from a logic of conflict based on the military force, to a new one focused on the economic and financial antagonism of the countries, has for the first time changed the concept of national security, and therefore, as a consequence, that one of national interest, placing the economic aspect in the foreground. In fact, since the armies have been substituted by the big corporations, and the commercial wars have replaced the traditional warfare, the threats linked to a possible external military aggression carried out according to the traditional canons have disappeared (or at least resized). In the meanwhile, the potential risks related to industrial espionage operations or to actions of economic interference driven by foreign powers, able to influence and even destabilize the national economics, have gained attention. Consequently, the economic aspect has not just returned to be present in the definition of national interest, but it has also gained momentum in the definition of national security. The wealth, and the economic and financial development of a country have therefore become, at the same time: i) measure of the power of a State, and implicitly a guarantee of national security; ii) value of national interest, as a condition for national security; iii) index of economic well-being of the community (by definition itself). And since the economic aspect becomes the cornerstone of the national interest and the national security, it is justified that, the nation-state assumes the responsibility of active intervention in the economic sphere. The EI, consequently, turns out to result as the fundamental tool to provide knowledge for conducting a national economic strategy aimed to pursue the national interest (and in the process to guarantee the national security). The EI can create, in fact, situations of information asymmetry, which could be used to pursue the national interest and guarantee the national security. For example, if a country A, by collecting information, is able to understand that in a specific period of time a country B has a high debt versus foreign entities, can put in practice a strategy of depreciation of its currency to support the export, without running any risk of seeing its action annulled by a similar depreciation of its currency by the country B (if country B reduce the value of its currency, its debt versus foreign entities will increase more). Another example is represented by the conduct of industrial espionage, which is nothing more than a form of public subsidy, led by a government for the benefit of its industry [2, 97]. A valid illustration in the real world of the impact of EI activities, in creating situation of information asymmetry can be easily individuated if we consider the recent information war between Ukraine and Russia, in which the use of an EI approach by the latter, by means of the threatening of the Ukrainian energy security, and the dissemination of deceptive information against the Kiev's government, have obtained results unachievable using only the traditional armed conflict. In the specific, according to the NATO Cooperative Cyber Defence Centre of Excellence in Tallin, Estonia, Russia used, together with traditional kinetic operations in Crimea and the Donbass, a new EI strategy consisting in disseminating and gathering information by means of spyware tools applied in the historical deep interconnected system of networks of the two countries. Thus, sophisticated cyber espionage campaigns, DDoS attacks, and information leaks against media or governmental organizations played the most significant role in creating damages in Ukraine [3].

As previous stated, the EI represents the fundamental tool to provide knowledge for conducting a national economic strategy aimed to pursue the national interest and to guarantee the national security, by creating and taking advantage of situations of information asymmetry. In order to do that, each country needs to play a proactive role in the complex networks of the international economic relations' system. That role, in the specific, embraces in some cases also the opportunity to create bilateral agreements o multilateral arrangements with other national entities in order to gain position in the geopolitical arena. The reasons for creating liaisons, formal or informal, among different countries are numerous. First of all, by means of bilateral agreements o multilateral arrangements a nation can increase its stock of data and, in the process, its knowledge to support the decision makers. Secondly, according to the idea that each country has a kind of specialization in the intelligence collection and analysis, in terms of specific data gathered (due to a focus on particular geographical areas or on a certain national threats), or in terms of specific instrument of data collection (human intelligence versus signals intelligence), the possibility to share information represents an interesting way to recuperate situations of lack of knowledge. Thus, for example, an hypothetical bilateral agreement between Ukraine and the USA, with the purpose of sharing some information, could represent an interesting opportunity for the former, in consideration of more sophisticated and expensive technical products (signals intelligence, cyber intelligence or imagery intelligence) covering near the whole globe, to which Ukraine would not otherwise have access [4], and an occasion of the latter to have access to significant human intelligence sources focused in the specific area of the Eastern Europe. However, the establishment of formal or informal liaisons among countries doesn't have only advantages. Several negative aspects should in fact be considered. First, each nation has dissimilar economic interests and differences in perceptions of threats for its national securities could exist [4, 534]. That restraint may prevent an efficient and effective collaboration among states and consequently making the agreement too expensive in consideration of the real benefits obtained. Additionally, in case of agreement between two countries with a deep gap in EI resources, there is also the risk of complaints about unfair burden-sharing [5, 309]. The more powerful state in term of intelligence gathering and analysis will tend to dominate the relationship, creating criticisms and suspicions. Finally, another intrinsic limit of formal or informal liaisons among nations aimed to increase the collection of information is represented by the fact that each country, notwithstanding it is involved in some agreement or arrangement, pursuits its own national interest, which in some way could enter in conflict with the national interest of another state. For that reason, the share of data is always incomplete, and limited to less strategic information, and the same channels of information sharing among countries could be used as further networks to implement a strategy of deception or for disseminate manipulated communications.

In the reality, there are some formal or informal liaisons among countries with the specific aim of exchange data and information related to certain areas of knowledge of common interests. For example, the North Atlantic Treaty Organization (NATO), an intergovernmental military alliance between 29 North American and European countries, was created on 4 April 1949 as a system of mutual defence in response to an attack by any external party. Nevertheless, during the Cold War, and after the fall of the Berlin Wall the Alliance played the role of network of a large amount of intelligence sharing concerning respectively military issues (on Soviet intentions and capabilities), and economic and political issues (on the development of economies of the East Europe countries and on threats linked to immigration flows and criminal activities). Another most famous intelligence alliance, known under the name "The Five Eyes", which embraces five countries: Australia (ASD – Australian Signals Directorate), Canada (CSE – Communications Security Establishment), New Zealand (GCSB – Government Communications Security Bureau), the United Kingdom (GCHQ – Government Communications Headquarters) and the United States (NSA – National Security Agency), was created again after the Second World War with the purpose to monitor the communications of the former Soviet Union and the Eastern Bloc by means of a sophisticated surveillance system (the ECHELON). The multilateral agreement (named UKUSA Agreement) was signed in 1948 in the form of a treaty for joint cooperation in signals intelligence and nowadays represents the most massive exchange in intelligence among countries in the globe. While the NATO and the UKUSA Agreement represent liaisons established with the original purpose of sharing information about military issues, other forums of cooperation among countries focus on intelligence exchange regarding other specific subjects considered of national interest. The Egmont Group of Financial Intelligence Units, for example, was created in 1995 for sharing intelligence in the financial area. That forum of cooperation, which encompasses 69 members, individuates in fact as main threat of the national security the negative impact in the economy of the money laundering, and the risk associated with the financial support to terrorism.

Within the Egmont Group, each adherent can exchange financial data for purpose of analysis, with the guarantee of protection and confidentiality of the information. The Kilowatt Group, instead, was created in 1977, at the instigation of Israel, in response of the attack by Black September at the 1972 Munich Olympic Games, as an instrument to share information, on a non-reciprocal basis, about terrorism [6, 182]. It includes Israel (represented by the MOSSAD – HaMossad leModi'in uleTafkidim Meyuchadim and by the Shin Beth), Canada, Norway, Sweden, Switzerland, the USA (represented by the CIA – Central Intelligence Agency, and by the FBI – Federal Bureau of Investigation), South Africa and some EU member states. Another important forum of intelligence sharing among countries is the Club of Berne. It was established in 1971, and it is based on voluntary exchange of secrets, experiences and problems regarding the collection of information. The Club of Berne includes 28 nations of the European Union, Switzerland and Norway, and in the last years its agenda includes items such as terrorism, communications interception, encryption, cyberthreats, and the role of intelligence within the EU. Finally, in the last decade, several approaches to establish liaisons for sharing intelligence within the European Union has been adopted. The EU Justice and Home Affairs Council has in fact realized that there is an urgent need to enhance cooperation among the intelligence services of the member countries especially in issues related to immigration, terrorism, cybersecurity, financial crimes, and economic development. The strong interest of the EU in finding new ways to increase the amount of data and information in order to create knowledge and to support the decision-maker in choosing the best strategy in line with the national (or supranational) interest demonstrates the relevance of the EI.

An analysis of recent research and publications

The EI and the more general Intelligence Studies have been object of numerous academic studies and practitioner's investigations. In the specific, among the more significant authors, it is worth to mention: Howerton [7] and his scientific and pragmatic approach to the EI; Gagliano [8] for his description of the French approach to the EI; Gill and Phythian [9] for their research of a scientific foundations for the intelligence studies. However, no one of the above cited contributes has used the graph theory analysis as instrument of scientific investigation, for developing new models of the EI.

The Purpose of the Paper

The purpose of the article is to use the graph theory in order to develop the scientific and theoretical foundations of the EI as instrument to pursue the national economic interest. In the specific, taking into consideration that the role of the EI consists in providing a country with the necessary knowledge to guarantee the national security, by playing a proactive role in the complex networks of the international economic relations' system, an innovative approach is introduced: three different models are presented. Those models are based on dissimilar economic levels of abstraction analysis, which represent a scientific logic description of the different EI approaches offered by the academic literature on the basis of the reference object. In the specific, according to the more complex and articulated third level of abstraction analysis, the EI could be described as a system (subject to geometrical variance) of entities, structures, scientific methods and instruments of analysis interconnected by means a common shared language, aimed to manage flows of data and diversified information, in order to generate the best possible understanding of the object of analysis, useful for supporting policies and decisions.

Presentation of the main material

The specific methodology used to introduce the three different levels of abstraction analysis and their respective models is based on the graph theory that is the theory of logical structures used to model pairwise relations between objects. The graph theory [10] is in fact a methodological body for modeling and solving decision-making problems, by dealing with the study of graphs. A graph is a discrete object, which can schematize a great variety of situations and processes, allowing analysis in quantitative and algorithmic terms.

The graph theory was introduced by the Swiss mathematician Leonhard Euler (Basilea, 1707- St. Petersbourg, 1783), who, using the instrument of graphs, formulated the problem of the seven bridges of Kцnigsberg. The problem was inspired by a real city and a concrete situation: the city of Kцnigsberg is crossed by the Pregel river and has two islands connected to each other and with the two main areas of the city by seven bridges (Fig. 1). The enigma to solve consisted in the possibility with a walk to follow a path that crosses each bridge once and once only. In 1736 Euler faced that problem, showing that the hypothetical walk was not possible (Fig. 2).

In the figure 2, in fact, a representation of the Konigsberg problem, using the graph approach, is depicted. In the specific, points A, B, C, D are called nodes and identify the two island and the other two main areas of the city connected with bridges. Lines a, b, c, d, e, f, g are called arcs or segments, and epitomize the seven bridges. Closed surfaces limited by a series of arcs are called regions. The number of edges coming out of a node is called the node order. For example, the order of node A is 5 while the order of node D is 3. Euler established that a graph

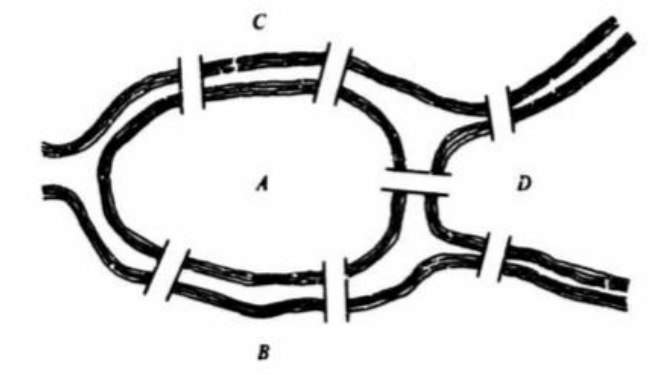

Fig. 1. The Seven Bridges of Kцnigsberg.
Source: Harary F., Graph Theory, Addison-Wesley Publishing Co. Inc. Massachusetts, 1969, pp. 1-2

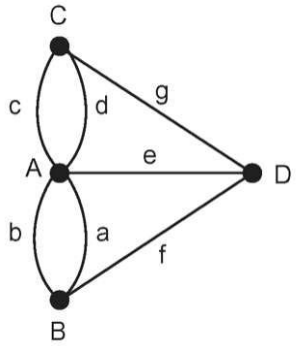

Fig. 2. Representation of The Seven Bridges of Kцnigsberg Problem by means of the Graph Theory.

consisting only of equal nodes, that is each one connected to an even number of edges, is always passable and that one can return to the starting point without path overlap (Eulerian circuit). If a graph contains even nodes and only two odd nodes is still passable, starting from one of the known odds to get to the other, but there is not opportunity to go back to the starting point. Finally, if it contains more than two odd nodes, it is not viable without path overlaps. Thus, as a consequence of the Euler's rules above enunciated, it is possible to affirm that the graph of the seven bridges of Kцnigsberg, having four nodes of odd order (respectively A 5, while B, C and D 3), is not viable without overlapping. Other than providing a solution to the problem of the seven bridges of Kцnigsberg, the graph theory could be used for the study of social relationships, and it is applied in different sectors of the social sciences: sociology, anthropology, psychology and economics. In particular, the use of the graph theory within the social networks focuses on the system of ties and liasons within a set of social actors, which could be a conceptualization of people, groups of people, companies, other organizations, or even nations (more interesting for the purpose of this study), and their relationships. In practical terms, thanks to the graph theory and the social network analysis, any social process or system, based on an interaction among different entities, could be represented and studied as a set of nodes and arches connecting pairs of units.

The EI is a formidable instrument, which provides a country with the necessary knowledge to pursue the national interest and to guarantee the national security. In a world that is characterized by strong interconnections due to the globalization, the development of ICT, and the diffusion of the liberal economic principles, the theoretical analysis of the EI should be conducted giving the proper importance to the logic of the networking, which represents the natural topology of the modern international economic relations' system. For that reason, the following levels of abstraction analysis used to investigate the EI and develop the three different models are based on the mathematical scheme of the graph theory. A graph is a mathematical structure described as an ordered triple comprising a set of vertices (entities that interact in the international economic relations' system); a set of edges (specific relations among entities); an incidence function mapping every edge to a pair of vertices. That description, in the specific, is used to conduct the abstraction analysis of the EI at a second and third level.

First level of abstraction analysis. At a first level of abstraction analysis, the economic intelligence can be simply defined as the set of information of a purely economic nature. That set of information, integrated with the knowledge related to other disciplines, provides the decision maker with a cognitive asset of important value, on the basis of which it is possible to take strategic or tactical decisions. The advantage of observing the EI using the first level of abstraction analysis consists on the fact that a definition like the one above presented has a wide versatility and flexibility, being applicable both in the public (nation state) and in the private (business and commercial) sectors, and in any historical or socio-political context. The last statement is easy to demonstrate, in consideration of the fact that an economic intelligence concept, as the one just introduced, can be used in every type of organization or social structure, without taking care of the dimension, and in every period of human history. Thus, it can be said that the EI has always been a priority component in the lives of human beings. Retracing the evolution of the people and their organizations in the course of the history, it is easy to identify numerous circumstances that underline the high interest attributed by the community, in different periods, to the EI. For example, the Bible narrates that Moses, in Sinai, at

the head of six hundred thousand Jews, before arriving in view of Canaan, was interested in having specific economic information about the geographic area (characteristics of the ground; presence of water; numbers of trees, etc.) [11, 22]. Similarly, a great historical leader like Alexander the Great considered the EI of decisive importance: he used, in fact, to ask to all the visitors who came from foreign lands about economical information (level of productivity of the foreign lands) [11, 30]. The importance of economic intelligence, however, reached its peak in 1300, a particular period commonly associated to the birth of economic espionage, whose main promoter can be represented by the maritime Republic of Venice. News with economic and commercial content (that is, the EI according the first abstraction level) was called Le Nove. They were considered of extremely importance because, together with information of a military and political nature, could provide the useful background of information necessary to pursuit the best decisions. Again, more recent examples of economic intelligence can be found in the numerous operations of industrial and economic espionage carried out in particular in the 800 (thefts of industrial secrets related to the development of steam engines), between the two world wars, and during the cold war. At this point, however, it is appropriate to spend some considerations on the differences in meanings attributed to the two types of offensive acquisition of economic information: industrial espionage and economic espionage. The term industrial espionage focus only in the activity, mostly illegal, committed by an individual or by an organization to the detriment of another entity, consisting in the theft or appropriation of a secret, which mainly concerns an aspect from nature industrial or technical-productive, with a view to its subsequent use for profit. Instead, economic espionage terminology pertains to a much broader concept, which also includes industrial espionage. In fact, the object of economic espionage is not exclusively limited to technological information (processes, projects and industrial patents), but encompasses all the information with an economic or commercial content (balance sheet data, price policies, business strategies), obtained either through OSINT and through covert sources. The economic espionage turns out to be the signifier of a much broader definition. In order to clarify the distinction advanced, it is possible to use as example of industrial espionage the theft of the Olympus engine and Concorde radar [2], which occurred in 1956 against the English-speaking consortium, by the high official of the KGB Serguei Pavlov. Instead, the methodical economic information gathering carried out, in the course of the cold war, by Americans against the Soviet state can be more properly assimilated, taking into account the strategic value of this complex operation, as a case of economic espionage. On the basis of the aforementioned interpretations given to the industrial espionage and to the economic espionage, it is possible to affirm that the definition of EI, which results from the first level of abstraction, is more consistent with the informative content of the second type of espionage. Similarly, Paul Howerton [7, 21], a former American official, employed in the CIA during the cold war, uses the expression economic intelligence, albeit with a markedly polemological imprinting, to identify the result of a process of estimation and analysis of economic information, collected both by illegal and lawful means (open source intelligence), concerning the ability of a nation to sustain a war. The US official identifies in particular certain aspects considered indispensable for observation: the degree of progress of scientific and industrial research; the economic-industrial power; and the reaction speed. In summary, on the basis of a logical model resulting from a first level of analysis abstraction, the EI can be well represented by the informative product of a technology watch process (although not only technological) and an economic espionage activity.

Second level of abstraction analysis. The model of economic intelligence, which emerges from the analysis conducted according to the first level of abstraction, appears as a static conceptual scheme, since the object of investigation is not represented by a process or by an organizational structure, but by a single material element: the information with an economic content. Furthermore, because of its high level of oversimplification (a feature that has the merit of making the model versatile and applicable to numerous social contexts and different historical periods), it does not provide conspicuous ideas useful for the definition of a theoretical paradigm of wide usefulness to an information system for safety. The only principle that can be drawn from the aforementioned scheme concerns the critical nature of economic information, and its tactical and strategic relevance (like any other information of a political, social or military nature), as a cognitive support to the definition of short and long term policies. Wanting to paraphrase this concept by means of the words of the English empiricist philosopher Sir Francis Bacon, who lived between the second half of the 16th and the early 17th century, it is possible to affirm that the conclusion, of a positive nature, to which the first level of abstraction of analysis reach, is that the knowledge represents the main factor of the human power. It appears clear that all the historical examples above presented, illustrating the high interest attributed by society to the EI in the course of history, are characterized by the desire to increase the

knowledge in order to increase the power, most often according to a strictly polemological view. In this sense, the history of the Republic of Venice, previously treated, was emblematic, where the political, economic and military power of the city was founded on the possession and the defense of "le Nove" (information with economic and commercial content). The situation of information asymmetry created by the greater or lesser degree of knowledge possessed by a country in favor of an enemy nation is therefore an element of fundamental importance at the strategic level, since it affects the balance of power between the different sovereign entities. By declining the concept in a commercial key, the company that has more economic information concerning the characteristics, the strengths and weaknesses, the strategies, and the production processes of its competitors, will enjoy a significant competitive advantage and therefore a greater contractual, economic and commercial strength. In order to better represent that new concept of the EI, regarding the interaction of two or more entities aimed to create and take advantage of a situation of information asymmetry, it is necessary to introduce a more articulated level of abstraction. The analysis grid used previously, according to the first level of abstraction, is built through the use of a single fixed point, considered essential to figure the economic intelligence: the information with an economic content. The second level of abstraction instead requires the definition of more fixed points, able to represent the different components of a new dynamic conceptual scheme aimed to extrapolate a more articulated representation of the EI concept. Specifically, in order to construct the new analysis grid, it is necessary to define three fixed points, that is, expressing the concept through an algebraic approach, a well defined triple (E, R, f), where: E represents a set of at least two elements, distinct entities belonging to the same organizational type (for example companies, or national entities), involved in the phenomenon of intelligence; R represents a set, separate from E, of oriented behaviors (i.e. conducts that allow to identify an active actor, which generates the action, and a passive one, which undergoes it); f a function of R in the Cartesian product E X E, which respects the anti-reflexive property (each entity of E can be related only to elements of E different from itself). Avoiding any further cognitive investigations of f, since it simply represents the binary relation that connects two distinct elements in E through a function contained in R, it is important for this purpose to analyze and define the E and R sets in greater detail. Set E is made up of all the actors involved in EI. In a broad sense, as previous mentioned, it encompasses all the various actors of the international relations' system. In a narrow sense, instead, the focus of the EI consists in its application to national entities. Set R consists in the complex of activities conducted by the actors involved in the EI, which can be organized in a well defined sequence of the following stages: identification of a problem (risk, threat or danger); definition of a set of information needs and relevant information sources; gathering and classification of data; analysis and interpretation of information; dissemination of the knowledge to the decision-maker. In summary, it is possible to affirm that the EI model, resulting from the second level of analytical abstraction, can be assimilated to an articulated activity of research, collection, evaluation, collation, classification, analysis, conservation activities, protection (counterintelligence) and dissemination of economic information useful to assist the productivity of a State, company or other institution, or to increase its economic competitive position, towards its opponents. That model is both applicable to a private context (competitive intelligence is in fact a discipline born within American multinationals), and public (the studies of the French intelligence school on the competitive strategy between economic systems and on the economic warfare represent it the most significant example), although the historical reference framework, unlike the economic intelligence model resulting from the first level of analytical abstraction (potentially applicable to each epoch), is limited to the period following the fall of the Berlin Wall, a watershed between a vision of conventional conflict, based on military force, and an unconventional view of war, in which armies are replaced by large enterprises, and the new forms of battle are mainly represented by hostile financial operations (f. e., speculation on currencies or on public debt of foreign countries), and by interference in the industrial economic structure of the enemy country (purchases of controlling shares of foreign strategic companies, economic and industrial espionage operations).

Third level of abstraction analysis. The model of EI that results analyzing the phenomenon at a first level of abstraction appears as a static conceptual scheme, whose reference grid consists of only one fixed point: the information with economic content, which represents a first interpretation of the intelligence phenomenon. The second level of abstraction requires instead the definition of three fixed points, the triple (E, R, f), to define a dynamic model that recognizes the EI as a complex of actions (R elements) of collection, analysis and dissemination of information useful for creating and exploiting situations of information asymmetry between two distinct entities belonging to the same organizational type (elements of E), for example companies, or national entities. The third level of abstraction differs

from the first two, as it requires the introduction of an additional level of complexity, which consists in the definition of a conceptual model of a relational type. In order to re-use the algebraic approach of the triple (E, R, f), to define the new analysis grid, it is possible to affirm that E continues to represent a set of at least two elements involved in the intelligence phenomenon, but this time not necessarily belonging to the same organizational situation; R maintains the same overall content, separated by E, of oriented behaviors; f expresses a function of R in the Cartesian product E X E, which, unlike the same relation adopted in the second level of abstraction, may or may not respect the anti-reflexive property (an element of E can also enter in relation with himself). The impacts of those that could appear small changes in the analysis grid generate deep and fundamental differences in the EI model. The model of the EI that appears at a second level of abstraction is applicable to both a private context, as it was born and used in competitions between large companies (micro-micro), and a public one, as a reference scheme in relation to the economic war among countries (macro-macro). Nothing, however, is told about the possibility of any dispute between a corporation (or a transnational criminal organization) and a national entity: the same industrial espionage activity, conducted by a government to the detriment of a foreign company, cannot be represented using the model resulting from the second level of abstraction. For that reason, in order to be able to take into account also macro-micro and micro-macro interactions, the analysis grid related to the third level of abstraction does not constrain the belonging of the elements of E to the same organizational situation. In fact, bearing in mind the social and political impact, described in the first paragraph, deriving from the phenomenon of globalization, countries has seen its sphere of influence decreasing in society, in favor of new players (multinationals; regionalisms; etc.), which start to interact with themselves. Another specificity of the third level of abstraction consists in the fact that the function f differs, in the new approach characterized by a greater degree of complexity, for the faculty, granted to it, to relate an element of E also with itself. This change is essential, as in this new system of analysis, the actor who comes into play in the economic intelligence is studied not as a single monolithic unit, but as a microsystem that interacts with other microsystems within a broader structure (macro-system). The reference model of economic intelligence at a third level of abstraction of analysis: i) describes each actors as a system of multiple components interacting with each other; ii) proposes different geometric interpretations of the EI coexisting and identifiable, one by one, on the basis of the different perimeters defined from time to time. In summary, according to the third level of abstraction analysis, the EI could be described as a system (subject to geometrical variance) of entities, structures, scientific methods and instruments of analysis interconnected by means a common shared language, aimed to manage flows of data and diversified information, in order to generate the best possible understanding of the object of analysis, useful for supporting policies and decisions. This is a particularly complex definition, which is based on the following three elements: i) geometrical versatile system; ii) common shared language; iii) management of information flows. Starting from the first point, it can be observed that the concept of system, referring to the taxonomy articulated on the basis of the object of study represents a fusion of all three meanings of intelligence most widespread in the doctrine: information, process, and complex of equipments. What emerges, in fact, is a definition of EI that modifies its content, enlarging or reducing the reference perimeter within the semantic map presented in the second paragraph of this chapter, in line with a semasiological approach. Consequently, the model that results at a third level of abstraction is potentially the entire semantic map itself, and all the possible areas that can be distinguished from time to time represent specific declinations of the to the particular scopes of application. About the common shared language, and the management of the information flow, it is worth to say that according to the third level of abstraction, it is necessary to possess a unequivocal method of interpretation, in order to avoid misunderstandings among the components involved in the process of providing intelligence to the decision makers. Furthermore, the dissemination of the knowledge among the whole organization (company, or national entity) becomes fundamental. The studies of the French intelligence school, which developed after the release of the Martre Report, identified as weaknesses of its previous model of EI, the compartmentalization of the tools and results related to the collection and analysis of information, which tended to remain of exclusive property of the competent public departments that has collected the data. That characteristic represents the opposite of the EI approach adopted by Sweden, Germany and Japan, countries in which "Information management is based on a collective and concerted practice" [8, 134]. The aforementioned nations have in fact based their system of economic intelligence on a common strategic goal, accepted and shared by all the actors involved, both public and private. As described in the following chapters, the model that results from a third level of analytical abstraction attributes a significant importance to the

connections among components of an organization (network) and to the economic information circulating in it. The network is, in fact, interpreted as a living being, a holistic concept whose meaning transcends the sum of the individual nodes, able to transmit, re-elaborate, and add value to the information. The information is in fact described as a flow of data and knowledge that transfers between different actors interconnected with each other. The idea of flow helps to describe both the dynamism of information, as it moves from one entity to another, and its fluidity, meaning by this term the lack of a specific objective and determined value capable of qualifying it. This indeterminacy of information derives in part from its indexicality, since any knowledge can take different contents in dissimilar contexts, and in part from the meaning that the ultimate user of such information attributes to the same, on the basis of a prejudicial mental model that can alter its perception cognitive. Thus, the shared information circulating within the system has an informative content, and therefore a value, potentially superior to the same information when it is collected and analyzed. Although it may seem like a minor issue, the implications for it have a double important practical impact, as they demonstrate: i) that sharing information within an information system generates synergies to the benefit of the whole system (Sweden, Germany and Japan represent a practical demonstration of this statement); ii) once introduced into a system, the evolution of information can not be determined, but only estimated with a probabilistic approach. The last observation is of particular importance, in deception operations, interference in foreign entities, and attempts at degeneration campaigns (the Russian attacks to the Ukraine represents just a typical example).

Conclusions

The EI is the search and the use of the information, in order to provide a country with the necessary knowledge to pursue the national interest and to guarantee the national security. The importance of this article is related to the fact that its results could complement and contribute to the expansion of knowledge on the economic intelligence, and its role on the management of the international relations. In particular, the models resulting from the different levels of abstraction could represent a useful and indispensable tool to formulate some general principles, which may constitute the foundation and the basic architecture of a new theoretical paradigm of reference for the development of the international relations, according a business administration approach. The new theoretical concept could allow having a better understanding of the interactions (agreements and conflicts) between national entities, supranational organizations, and multinational corporations, in a globalized world, where the fundamental element is represented by the search of the economic information to take a competitive advantage against other entities.

REFERENCES

1. Wolfers, A. (1952). "National Security" as an Ambiguous Symbol. *Political Science Quarterly, 67:4,* 481 [in English].

2. Potter, E. H. (1998). Economic Intelligence & National Security. *Carleton University Press, Carleton* [in English].

3. Geers, K. (2015). Cyber War in Perspective: Russian Aggression against Ukraine. *NATO CCDCOE Pubblications,* Tallin, Estonia [in English].

4. Lefebvre, S. (2003). The Difficulties and Dilemmas of International Intelligence Cooperation. *International Journal of Intelligence and Counter Intelligence, 16:4,* 527-542, DOI: 10.1080/716100467 [in English].

5. Richelson, J. T. (1990). The Calculus of Intelligence Cooperation, *International Journal of Intelligence and Counter Intelligence, 4,* 309, DOI: 10.1080/08850609008435147 [in English].

6. Kahana, E. & Suwaed, M. (2009). The A to Z of Middle East Intelligence. *The Scarecrow Press, Inc., Toronto,* 182 [in English].

7. Howerton, P. W. (1956). Economic Intelligence. *Studies in Intelligence, CIA, 1(Spring),* 21 [in English].

8. Gagliano, G. (2013). La Nascita dell'Intelligence Economica Francese. *ARACNE editrice S.r.l.,* Roma, 134 [in Italian].

9. Gill, P., Marrin, S., & Phythian M. (2009). Intelligence Theory. *Key Questions and Debates,* Routledge [in English].

10. Gross, J. L., Yellen, J., & Zhong P. (2014). Handbook of Graph Theory. Second Edition. *CRC Press, Taylor & Francis Group* [in English].

11. Vecchioni, D. (2007). Spie. Storia degli 007 dall'Antichita all'Eta Moderna, *Editoriale Olimpia, Sesto Fiorentino,* 22 [in Italian].

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ВИКОРИСТАННЯ ТЕОРІЇ ГРАФІВ ДЛЯ ДОСЛІДЖЕННЯ РОЛІ ЕКОНОМІЧНОЇ РОЗВІДКИ ДЛЯ НАЦІОНАЛЬНОЇ БЕЗПЕКИ

Адамі К.

Дана стаття надає повний та всебічний аналіз ролі економічної розвідки як інструменту для досягнення національних інтересів та гарантування національної безпеки. Проаналізовано Весфалійський підхід та його уточнення з соціально-економічної точки зору до тлумачення національних інтересів. Підкреслено економічний аспект національного інтересу, а також наголошено на набутті його значення у визначенні поняття національної безпеки. Для цього, використовуючи математичний підхід, що випливає з теорії графів, представлено три різні інноваційні моделі. Дані моделі базуються на різних економічних рівнях абстрактного аналізу, які представляють науковий логічний опис різних підходів економічної розвідки, запропонованих академічною літературою на основі еталонного об'єкта. На першому рівні абстрактного аналізу економічна розвідка визначена як сукупність інформації суто економічного характеру. Підкреслено, що другий рівень абстрактного аналізу вимагає визначення більш фіксованих точок, здатних представляти різні компоненти нової динамічної концептуальної схеми, спрямованої на екстраполяцію більш сформульованого представлення концепції економічної розвідки. На специфічному, більш складно сформованому, третьому рівні абстрактного аналізу, економічна розвідка може бути охарактеризована як система (суб'єкт геометричної конфігурації) понять, структур, наукових методів та інструментів аналізу, пов'язаних між собою за допомогою загальної спільної мови, спрямована на управління потоками даних та диверсифікованою інформацією, щоб генерувати якнайкраще розуміння об'єкта аналізу, корисного для підтримки політики та рішень. Доведено, що спільна інформація, що циркулює в системі, має інформативний зміст, а отже, значення, яке потенційно вищі, ніж у процесах її збору та аналізу. Наслідки спільної інформації мають подвійний важливий практичний вплив, оскільки вони демонструють породження синергії на користь всієї системи, а також відсутність визначення еволюції інформації, але лише її оцінку з імовірнісним підходом.

Ключові слова: економічна розвідка, міжнародні зв'язки, інформаційна асиметрія, знання, теорія графів, національна безпека.

ИСПОЛЬЗОВАНИЕ ТЕОРИИ ГРАФОВ ДЛЯ ИССЛЕДОВАНИЯ РОЛИ ЭКОНОМИЧЕСКОЙ РАЗВЕДКИ ДЛЯ НАЦИОНАЛЬНОЙ БЕЗОПАСНОСТИ

Адами К.

Данная статья представляет полный и всесторонний анализ роли экономической разведки как инструмента для достижения национальных интересов и гарантирования национальной безопасности. Проанализирован Вестфальский подход и его уточнение с социально-экономической точки зрения к толкованию национальных интересов. Подчеркнуто экономическое содержание национального интереса, а также акцентировано внимание на повышении его значения в определении понятия национальной безопасности. Для этого, используя математический подход, который вытекает из теории графов, представлены три инновационные модели. Данные модели базируются на разных экономических уровнях абстрактного анализа, которые представляют научное логическое описание разных подходов к экономической разведке, предложенных в академической литература на основе эталонного объекта. На первом уровне абстрактного анализа экономическая разведка определена как совокупность информации сугубо экономического характера. Подчеркнуто, что второй уровень абстрактного анализа требует определения более фиксированных точек, способных представить разные компоненты новой динамической концептуальной схемы, направленной на экстраполяцию более сформулированного представления концепции экономической разведки. На специфическом, более сложно сформулированном, третьем уровне абстрактного анализа, экономическая разведка может быть охарактеризована как система (субъект геометрической конфигурации) понятий, структур, научных методов и инструментов анализа, связанных между собой при помощи общего языка, направленной на управление потоками данных и диверсифицированной информацией для формирования лучшего понимания объекта анализа, а также используемой для поддержки политики и решений. Доказано, что общая информация, циркулирующая в системе, имеет информативное содержание, а, значит, и ценность, потенциально выше, чем в процессах ее сбора и анализа. Последствия общей информации имеют двойное важное практическое влияние, поскольку они демонстрируют порождение синергии в пользу всей системы, а также отсутствие определения эволюции информации, а только ее оценку с помощью вероятностного подхода.

Ключевые слова: экономическая разведка, международные связи, информационная ассиметрия, теория графов, национальная безопасность.

THE USE OF THE GRAPH THEORY TO INVESTIGATE THE ROLE OF THE ECONOMIC INTELLIGENCE FOR THE NATIONAL SECURITY

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The present article provides a complete and comprehensive analysis of the significance of the Economic Intelligence as an instrument to pursue the national interest and to guarantee the national security. The Wesfalian approach and its social-economic connotation to interpretation of the national interest have been analyzed. The economic aspect of national interest has been highlighted, as well as its gaining the momentum in the definition of national security has been underlined. For that to be done, by using the mathematical approach deriving from the graph theory, three different innovative models are presented. Those models are based on dissimilar economic levels of abstraction analysis, which represent a scientific logic description of the different Economic Intelligence approaches offered by the academic literature on the basis of the reference object. At a first level of abstraction analysis the economic intelligence has been simply defined as the set of information of a purely economic nature. It has been underlined that the second level of abstraction instead requires the definition of more fixed points, able to represent the different components of a new dynamic conceptual scheme aimed to extrapolate a more articulated representation of the Economic Intelligence concept. In the specific, according to the more complex and articulated third level of abstraction analysis, the Economic Intelligence could be described as a system (subject to geometrical variance) of entities, structures, scientific methods and instruments of analysis interconnected by means a common shared language, aimed to manage flows of data and diversified information, in order to generate the best possible understanding of the object of analysis, useful for supporting policies and decisions. It has been proved that shared information circulating within the system has an informative content, and therefore a value, potentially superior to the same information when it is collected and analyzed. The implications for it have a double important practical impact, as they demonstrate the generation of synergies to the benefit of the whole system as well as an absence of determination of evolution of information, but only estimation with a probabilistic approach.

Keywords: economic intelligence, international relations, information asymmetry, knowledge, graph theory, national security.

REFERENCES

1. Wolfers, A. (1952). "National Security" as an Ambiguous Symbol. *Political Science Quarterly, 67:4,* 481 [in English].

2. Potter, E. H. (1998). Economic Intelligence & National Security. *Carleton University Press, Carleton* [in English].

3. Geers, K. (2015). Cyber War in Perspective: Russian Aggression against Ukraine. *NATO CCDCOE Pubblications,* Tallin, Estonia [in English].

4. Lefebvre, S. (2003). The Difficulties and Dilemmas of International Intelligence Cooperation. *International Journal of Intelligence and Counter Intelligence, 16:4,* 527-542, DOI: 10.1080/716100467 [in English].

5. Richelson, J. T. (1990). The Calculus of Intelligence Cooperation, *International Journal of Intelligence and Counter Intelligence, 4,* 309, DOI: 10.1080/08850609008435147 [in English].

6. Kahana, E. & Suwaed, M. (2009). The A to Z of Middle East Intelligence. *The Scarecrow Press, Inc., Toronto,* 182 [in English].

7. Howerton, P. W. (1956). Economic Intelligence. *Studies in Intelligence, CIA, 1(Spring),* 21 [in English].

8. Gagliano, G. (2013). La Nascita dell'Intelligence Economica Francese. *ARACNE editrice S.r.l.,* Roma, 134 [in Italian].

9. Gill, P., Marrin, S., & Phythian M. (2009). Intelligence Theory. *Key Questions and Debates,* Routledge [in English].

10. Gross, J. L., Yellen, J., & Zhong P. (2014). Handbook of Graph Theory. Second Edition. *CRC Press, Taylor & Francis Group* [in English].

11. Vecchioni, D. (2007). Spie. Storia degli 007 dall'Antichita all'Eta Moderna, *Editoriale Olimpia, Sesto Fiorentino,* 22 [in Italian].