

# Why Information Grows? The evolution of order, from atoms to economies

## Introduction

Economic growth is one of the main concerns of modern societies. Although many countries have great natural, productive and human resources and purchasing power making it possible for them to design and set up a strong, dynamic, advanced economy, many of them continue to be tied to dependent, lethargic or unsustainable economic growth processes. Ubiquity is therefore one of the main features of modern economic development. Hidalgo puts forward the idea of economic complexity as the main driving force for the development of modern economies. The key now lies not so much in traditional production factors but rather in the information a specific society – people, groups, companies and institutions - is capable of processing and sharing through networks in order to generate knowledge and productive know-how.<sup>1</sup>

Setting aside the traditional victimism that dominates the discourse of many countries which do not manage to achieve optimum economic development, but without disparaging the validity of their arguments, in his book *Why Information Grows*, César A. Hidalgo (Artificial and Natural Intelligence Institute at the Université Fédérale Toulouse Midi-Pyrénées and founder of Datawheel LLC) suggests a new approach to economic growth. This is based on the capacity to construct reality through the imagination - as crystals of solidified imagination – rather than the possibility of buying, consuming, selling or producing. Taking this as a starting point, Hidalgo puts forward the idea of economic complexity as the main driving force for the development of modern economies. The key now lies not so much in traditional production factors but rather in the information a specific society – people, groups, companies and institutions - is capable of processing and sharing through networks in order to generate knowledge and productive know-how.

In the first chapter, “The Secret to Time Travel”, Hidalgo looks in depth at the difference between two fundamental capacities linked to the computing that is crucial for accumulating information in the economy and society: knowledge and know-how. Knowledge is what allows us to explain and predict the results of something, like an action, through the establishment of links or relationships between organisations without the need for it to form part of the process; while know-how is what underlies the actions we carry out even though we may not be able to explain how.

In the second chapter, “The Body of the Meaningless”, Hidalgo explores the idea of information expressed by Claude Shannon, father of communication theory and one of the first theorists of Artificial Intelligence, and its relevance today. Shannon, together with his colleague Warren Weaver, extracts the traditional sense of the concept information as “meaning” and its mathematical content as “data”. In this way, Shannon manages to show information as “the smallest volume of data necessary to be able to specify a message”. Machines could therefore be designed capable of transmitting information from one point to another without the need to worry about its meaning. However, there is no mention of Shannon’s theorem of the imperfection of information.

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Patrici Calvo

Universitat Jaume, Spain

**Correspondence:** Dr. Patrici Calvo, Universitat Jaume I, Spain, Email calvop@uji.es

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In the third chapter, “The Eternal Anomaly”, Hidalgo reflects on the irreversibility of time and the origin of information. To do this, he combines ideas from Ilya Prigogine and Erwin Schrödinger to explain where information comes from (a stationary state that is out of balance); how it can be generated and can last longer (because it is stored in solids) and what allows it to grow: the capacity of computing equipment. As a result, Hidalgo demonstrates that information is prebiotic, much older than the appearance of human beings and primarily lacking meaning. It is irreversible in time because of the instantaneous nature of reality and the phenomenon of the entropic barrier, and its complexity increases with its richness.

In the fourth chapter, “Out of Our Heads”, Hidalgo concerns himself with reinterpreting the world, particularly the economic world, as crystals of solidified imagination. In the case of economics, as he interprets the products and services in the market as exchanges of human imagination, 19th-century economic concepts such as the balance of payments are shown to be incomplete, lacking important information that would provide an understanding of the difference between a country’s wealth and its economic development. While wealth is related to those who possess and extract a specific raw material, such as copper, for example, or produce something with it, like pipes or electric cables, economic development has a lot more to do with those who imagine a possible application of the material and crystallise their information in a stable, exportable product or service. Economic development is therefore not related to capacity to buy or consume or sell or product, but rather to the construction of reality through the imagination, and this requires a large quantity of knowledge and know-how. Thus, we can see how economically more developed countries are not necessarily those that are wealthier in raw materials or produce more products.

In the fifth chapter, “Amplifiers”, Hidalgo analyses the practical uses of the human capacity to crystallise imagination, including the distribution of the practical uses of knowledge and know-how. He also suggests that products are means of creative expression, human enrichment and combinatorial creativity. Hidalgo’s view is that we want to crystallise our imagination in the form of products for many reasons, including their capacity to enrich and improve human capabilities; improve people’s welfare by sharing our creativity, points of view and moods with others; and increase individual knowledge and its benefits for ourselves and others through the contributions of others, in a sense very similar to the idea “on the soldiers of giants” expressed by Robert Burton (1577-1640)<sup>2</sup> in his book *The Anatomy of Melancholy* (1628). So, beyond its capacity for the efficient

management of scarce resources and wealth generation, the economy can be valued for its capacity to both amplify knowledge and the human imagination, and for offering direct access to this knowledge via the market. The greater the imaginary information we deposit around us, the more complex economies can be, and the greater their capacity to amplify knowledge and offer direct access to it.

In the seventh chapter, called “Links are not Free”, Hidalgo explores the possibility of going beyond the finite capacity of people –the personbyte – and companies –the firmbyte– to accumulate knowledge and know-how. For Hidalgo, the key is in understanding that people’s and companies’ limits on quantifying information for creating complex products can be increased through relational and communicative structures for exchanging and distributing knowledge and know-how. In other words, the larger and more professional the exchange and distribution network, the greater the capacity of people and businesses to create complex products. Hidalgo uses this to show why the most complex products are limited to a few places in the world and, therefore, why there are different levels of economic development. Nowadays, a complex technological product, such as Apple’s iPhone, requires the cooperation of many people at the conception and design stages, and many firms in actually creating it. And the more complex and demanding this cooperation is, the greater the capacity of those involved to generate more complex products of crystallised imagination. This chapter opens the door to an analysis of the different types of reciprocity for establishing cooperative processes tending to satisfy shared objectives, such as reciprocal selfishness, reciprocal altruism, indirect reciprocity, social reciprocity, strong reciprocity, unconditional reciprocity, transitive reciprocity, inclusive reciprocity, institutional reciprocity and cordial reciprocity.<sup>3</sup>

In the eighth chapter, entitled “In Links We Trust”, Hidalgo makes an in-depth study of the main features of the cooperative structures that make it possible to go beyond people’s and firms’ information quantification limit: the personbyte and the firmbyte. To do this, Hidalgo looks at James Coleman’s theory of social capital and the neoinstitutionalist theory developed by Ronald H. Coase and Oliver Williamson to suggest that the emergence, subsistence and development of such structures depends on extensive relational and communicative networks forged from three fundamental values: professionalism, cooperation and, above all, trust. Here, however, it would have been good to have seen more on both theories. For example, the contributions of Elinor Ostrom (2000, 2003),<sup>4,5</sup> a neoinstitutionalist colleague of Coase and Williamson who worked hard on how to generate the necessary trust to establish, maintain and develop cooperation in such relational networks. There could also have been greater analysis of the role played by reciprocity in generating trust and, therefore, in increasing the likelihood that cooperative links emerge and develop.<sup>4</sup>

In the ninth chapter, called “The Evolution of Economic Complexity”, Hidalgo examines the geographical location of knowledge and know-how. To do so, Hidalgo compares the industrial concentration of products whose manufacture is not greatly diversified and highly nested, such as optical instruments, aircraft and medical diagnosis devices, with the industrial concentration of products whose manufacture is highly diversified and not greatly nested, such as textile garments.

In the tenth chapter, entitled “The Sixth Substance”, Hidalgo is concerned with the generation, characterisation and measurement of the knowledge and know-how collectively accumulated by a

society through social relationships to show the relationship between complexity and economic growth. To do this, Hidalgo starts with the traditional production factors to show that the economic theory of the 20th century does not match reality, focusing as it does on the economic value of the human capital, knowledge and know-how accumulated by individuals and ignoring the economic value of the social capital, knowledge and know-how accumulated in social relationships. To explain the potential of social capital, Hidalgo looks in depth at the difference between connective and cohesive social capital. Connective social capital describes networks of relationships between individuals who do not know one another but in which the indirect information accumulated makes it possible to generate the trust required for them to be able to sell, negotiate and manage a product or service between them. Cohesive social capital is a complement to connective capital, describing the networks of relationships between individuals, organisations and institutions that do know one another and interact repeatedly for different reasons and with different aims. So, to be able to identify the complexity of an economy, Hidalgo advocates focusing attention on diversity and not just on the stock or quantity of physical capital available in a society. The idea is to describe an economy for its capacity to accumulate elements (physical capital) as well as to incorporate diversity and to produce highly complex products. This requires quantifying the number and diversity of the elements available, as well as the identity of complexity. Quantifying the number of technology companies and the number of workers they have is important, but it is much more important to know information about the differences and different relationships between the companies, the number and type of products they generate, the emoluments the employees receive, the level of affectiveness between the stakeholders, and so on. This second part makes it possible to identify the complexity of the sector and, therefore, the level of economic growth achieved. However, it would have been good to see more in this chapter on the role played by optimum management of the ethical dimension in increasing complexity and economic growth.

In the eleventh chapter, entitled “The Marriage of Knowledge, Know-how and Information”, Hidalgo explores the mechanisms through which economic systems are capable of making information to grow continuously, quantifying it and creating crystals of imagination. Adopting a biological and historical perspective, Hidalgo compares groups’ capacity to package and deploy knowledge and information with mechanisms from biology. Unlike biological ecosystems, the possession of information does not guarantee that a particular social group can turn it into knowledge and productive know-how. Wide, diversified networks of relationships are what allow complex economies to have mechanisms capable of quantifying information and generating crystals of imagination.

## Conclusion

Ultimately, with this book, Hidalgo offers a very original and highly illustrative approach to the assumptions underlying economic growth in modern societies based on the complementary nature of two perspectives: social sciences and information sciences. Hidalgo also offers interesting tools and methods for measuring economic development based on Big Data technology, which provides information making it possible to guide the design or redesign of economic policies. And, finally, Hidalgo raises the idea of information linked to the management of the ethical dimension of economic practice as one of the factors determining the measurement of complexity and, therefore, economic growth. A lack of fair wages, proper welfare indices and optimum levels of trust in a specific

sector, for example, is synonymous with a lower level of economic complexity – and this implies lower economic growth.

For all these reasons, I believe this is an original and certainly a revealing contribution capable of integrating different perspectives –economic, physical, social, communicative, technology or ethical. As such, it allows a greater comprehension of economics, as well as creating space for interdisciplinary dialogue offering new perspectives and lines of research in different fields. It is a contribution integrating other approaches and plotting a clear course at the intersection between sciences and humanities.

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None.

### Conflicts of interest

The authors declare no conflicts of interest.

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