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Table of contents

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Abstract

The advent of the knowledge economy has transformed the behavior of economic agents and the nature of transactions. In particular, the increase of knowledge based transactions not associated with monetary flows is weakening the significance of traditional measures of economic dynamics like gross domestic product (GDP) or national income (NI). The objective of the working paper is to improve the measurement of new economic dynamics introducing a model that measures and explains *Economic Order* in the knowledge economy driven by the agents of *Governance*, *Wealth*, *Conflict* and *Mutuality*. Income, a component of the *Wealth* agent, is an independent variable of the model. Its maximization is not an objective within the analyzed economic framework. Therefore, income and production growth are not primary goals, but instead they make a complementary contribution to *Order*. Besides, *Welfare* is not built exclusively on the optimal distribution of income, and sourced on individual utility and preferences, but on the economic order of the system. The *Transaction* is the vehicle that constitutes the minimal unit facilitating or preventing exchange within and among the economic agents. An empirical analysis is performed over a cross-sectional sample of quantitative and qualitative data of 142 countries of the world economy in the period 2010-2011. A Logit regression is constructed where the dependent variable explaining *Order* is an index denominated *Disentropy*. Lower *income inequality* (Gini) does not mean a higher level of *Order.* As an economy achieves more economic order *Wealth* becomes a less relevant agent. *Human development* (HDI) is positively correlated with economic order. The *Disentropy* linear function is normalized to obtain a Cobb-Douglas analogous function. This function is twice differentiable and its hessian is lower than zero evidencing a concave behavior of the *Disentropy* variable. Hence *Order* presents decreasing outputs to scale across the considered sample of countries. A ranking of world top ordered economies is listed probably having the following common features among them: knowledge intensive, international focus, small population, homogeneous culture, self-identity, solid institutions and mainly democratic.

Keywords

Knowledge economy, Economic Order, Disentropy, Transactionality, Logit regression.

Introduction

During the last two centuries the science of economics has focused on explaining *economic growth* and *social welfare* understood as the fair and egalitarian distribution of income among the population. The theoretical models that develop the two independent lines of research of *economic growth* and *social welfare* sustain that the maximization of income and production constitutes an end; therefore in these models income and production are always the dependent or response variables.

The German economist Silvio Gesell introduced the term of natural economic order referring to the order in which men compete on equal terms, the leadership falls to the fittest and all privileges are abolished (Gesell, 1916). Nobel laureate economist Friedrich August von Hayek stated that economic order is achieved when the best use of resources of the economy is made known to all members of society. In the end, for Hayek the construction of a rational economic order requires that knowledge is made available as widely as possible across all economic agents (Hayek, 1945, 1948).

We have chosen the term economic *Order* to denominate the object of this research as we believe it gathers the attributes of wealth, social welfare and equality of an economy. *We presume an economy attains a situation of Order when it is provided with a suitable institutional framework, efficient governance practices, a fair distribution of wealth, a non-conflict environment without corruption and wars, and an advanced and pervasive technological platform across all domains of society. Economic Order is not a dichotomic attribute that an economy has or has not, but a distinguishing quality appraising the welfare, distributive justice and freedom of an economy which can be measured in relative terms with respect to other economies.*

Institutions are the rules of the game of society (North, 1996) constituting the human constructed framework of the economic activity. The smallest unit of economic activity that makes up such a framework is the *transaction*. The set of transactions that form the economy is fundamentally a disordered system. We denominate *entropic growth* the combination of net economic growth and increasing inequality. Ultimately an individual transaction contains the principles of *Conflict*, *Mutuality* and *Order* (Commons, 1932). In order for an economy to achieve a *leveled growth* it is a matter of reducing *Conflict* and maximizing *Order* by fostering *Mutuality*. Due to the fact that transactions whether in the form of employment relations or intermediate product market transactions (Williamson, 1998) are the irreducible unit of the economic activity, *contracts* and subsequently *institutions* and *governance* acquire a crucial role in an economy. In this respect Buchanan (1975) differentiates the consideration of economics as a *science of choice* during the XX century from the current approach of economics as a *science of contract*.

The understanding of growth mechanisms is a central subject of orthodox economics that pursues to find out laws explaining past economic phenomena in order to understand the current economic reality and to make predictions on the future. First equations to model economic growth

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were set up during the first half of the XX century by pre-neoclassic economists that attempted to explain the relation between income, capital and labor (Harrod, 1939; Domar, 1946). In fact, an explicit regression equation representing the relationship between production (dependent variable) and capital and labor (independent variables) was formulated earlier by Cobb and Douglas (1928). In the 1950's a technological exogenous variable was introduced in income growth regression equations (Solow, 1956, 1957; Swan, 1956). During the 1980's and 1990's (Lucas, 1988; Romer, 1990, 1994) developed complex endogenous growth models in which technology was a variable determined within the model.

The models developed by the orthodox school, which includes neoclassical and endogenous growth approaches, assume a frictionless economy where transaction costs are zero, agents have all information about each other and institutions do not have an impact or at least such impact is not considered in the models. These circumstances determine that orthodox models confer an explanation of growth that gives limited solutions, only applicable to specific moments in time under conditions overlooking the imperfect and uncertain attributes of the economic activity.

On the other hand, heterodox economists bring in additional transversal drivers to economic growth sourced on the human and subsequently cognitive descent of the economic activity. Under this other framework, conventional economic factors like labor, capital and technology interplay with social, cultural, historical and institutional factors. Human behavior is an unpredictable element; therefore, rational expectations cannot be a given truth or principle when constructing broad scope growth models.

We are denominating *economic optimizers* the agents that contribute to the attainment of a leveled growth, namely *institutions*, *technology*, *entrepreneurship*, *education* and *innovation*. Institutions are the vehicle through which the other agents impact and order the economic activity. An ambitious challenge of today's heterodox economics, which constitutes the seed of this paper, resides on connecting *new institutional economics* with *transaction cost economics* and *evolutionary economics* in the context of the *knowledge economy*. Most transactions of the industrial economy had a monetary basis (work for salary, investment for return and product for price). In the knowledge economy transactions do not necessarily have a monetary foundation. Exchanges of knowledge for knowledge might not give rise to monetary flows falling outside gross domestic and national income measurements.

The purpose of this paper is to analyze how the combination of suitable economic optimizers, namely *Governance*, *Wealth, Conflict* and *Mutuality***,** has an effect on the achievement of a leveled (*ordered*) economic growth. The investigation is conducted in a context characterized by the attributes of scarcity, increasing transaction costs, imperfect information and uncertainty. In order to overcome the constraints of adding human behavior transversal factors, a crucial objective of our enquiries entails the understanding of the cognitive ancestry - individual as well as collective - of the economic activity (Arthur, 2000).

In particular, the paper focuses on the study of the interaction of the variables of *Governance* (implicitly public and private institutions, property rights spreading and governmental regimes), *Wealth* (implicitly income and production), *Conflict* (implicitly terrorism, crime and political and economic transparency) and *Mutuality* (implicitly political and economic transactional exchange

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enablement and technological progress), and its influence on the ordered and leveled *growth* and *welfare* of an economy. First a review of the existing theories related to the field object of study is carried out. Secondly, a theoretical model of economic order is proposed. Finally, an empirical exercise with selected quantitative and qualitative data belonging to a cross-sectional sample of 142 countries of the world economy is performed to assess and test the model.

1. Economic order, equilibrium and growth

In his *Principles*, Alfred Marshall presented a visionary definition of the science of Economics stating that it is *the study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of wellbeing. Thus it is on one side a study of wealth; and on the other, and more important side, a part of the study of man* (Marshall, 1997). A revision of this definition under the *knowledge economy* fundamentals requires the incorporation of novel immaterial factors that play an important role in order to achieve wellbeing. The shift from an industrial economy towards a knowledge economy is characterized by the increasing relationship between information and communication technologies (ICTs) and knowledge (Neef, 1998; Pérez, 2002; Rodrigues, 2002; Foray, 2004; Rooney et al., 2005; Vilaseca and Torrent-Sellens, 2005; Dolfsma and Soete, 2006; Torrent-Sellens, 2012). During the decade of the 90' a number of technological developments[1] determined unprecedented changes in society and extensively in the economic and organizational configuration of the world. ICTs are general purpose technologies (Bresnahan and Trajtenberg, 1995; Jovanovic and Rosseau, 2006) that increase the accumulation and productivity of knowledge in a process interconnected with disruptive social and cultural changes (Baily and Lawrence, 2001; Baily, 2002; Gordon, 2004). Higher connectivity has transformed the world into a twenty-four hours a day socioeconomic ground. Pervading network organizations and increasing transactional environments without borders have culminated in the globalization phenomenon. Therefore, nowadays intangible agents, namely knowledge, and in particular technological know-how, constitute production factors in addition to classical land, labor and capital. This new framework has led to the emergence of transactions which are not offset by monetary counterparts, like for instance the exchanges of knowledge for knowledge inherent in some forms of collaborative activities. The insurgence of new economic dynamics raises the need of developing new models for measuring the economic activity.

In the twentieth century economics evolved and consolidated as a social science. Classical and neoclassical economists strove to explain economic *equilibrium* and *growth* and produced an array of approaches addressing these two key landmarks of the field of economics.

1. We refer to the Information and Communication Technologies (ICT) that comprise the converging set of developments in the fields of microelectronics, telecommunications, optoelectronics and information technologies including Internet.

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Under the classical approach, a microeconomic equilibrium is achieved at the intersection of the demand and supply curves when the quantities and prices of a given product determine maximum profits for companies and maximum utilities for consumers (Walras, 1954). Therefore, equilibrium arises as result of a process of price formation and maximization of profit and utility achieved by the agents of the system. The classical understanding of equilibrium elevates prices and subsequently the maximization of the basic production function $Y = p \times q$ to a superlative position as opposed to human and social behavioral components.

In the mid-twentieth century neoclassical economists lead by Solow (1956) brought up a macroeconomic model of long run growth in which the steady state level of capital and output could be compared to a sort of equilibrium stage of the economy. In fact, neoclassical economists refer to the steady state as the one that determines growth equilibrium or in other words a balanced economic growth.

Arrow and Debrew (1954) formulated two theorems to explain equilibrium in a competitive economy stating that: (1) in order for an economy to reach equilibrium all individuals must dispose of a minimum quantity of every commodity available for sale; and (2) each individual can supply the economic ground with at least a labor category that has a positive effect at any step at the production chain of the previously mentioned commodities.

These authors set forth the seminal ideas that later on evolved into the modern general equilibrium theory[2]. Other economists adhered to this approach constructing models on the basis that the value of a good to an individual is determined by consumer preferences, technology and distribution of wealth (Mas-Colell, 1974; Shafer and Sonnenschein, 1975). In the end, this relevant approach to equilibrium - the general equilibrium theory – starts, as well as the walrasian approach, on the analysis of supply and demand behavior and the value determination of goods in order to explain dynamic price stability scenarios.

Growth models developed by orthodox economists are formalized through complex mathematical models and regression equations where production is the dependent variable[3] and land, capital and labor the independent or explanatory variables. In fact other factors like technology and human and social capital are considered in growth equations as well. Extensive research by sound specialists in the field leads to the final conclusion that all solutions (regression equations) seem to be fragile (Levine and Renelt, 1992) as it is impossible to build a unique model covering all situations (Sala-i-Martin, 1997).

Economic theories up till the end of the XX century focused on developing models around *Wealth*. The measure of *Wealth*, delimited under the façade of either *production* or *income* - or both of them at once - was the ultimate recurring dependent or explained variable. Henceforth, *Growth* and *Equilibrium* theories set the path of progress of the science of economics during this time in history.

2. The General Equilibrium Theory is sourced on the classical conception of equilibrium developed by the French economist Leon Walras.

3. The dependent variable measures the variation of total production or income across a section of elements (individuals, firms, countries or regions of the world economy) determining growth or *degrowth* over time.

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On the turn of the XX century and the beginning of the XXI century, following the advent of the new digital and communication technologies, internet and emerging network and collaboration frameworks, a new variable picking up the resulting exchange enhancement across all spheres of the economic activity acquires increasing relevance. We will characterize this new variable under the attribute of *Mutuality.*

Following Commons (1932), *transactions* are the basic units on which the science of economics is built. The study of *order* in an economic system requires an analysis based on the evaluation of *transactional* dynamics within it. First it is necessary to define the agents and players of the transactions making up the economic activity and next to study the connections and exchange flow among them.

This paper keeps aside the thesis that the growth of income or production, and subsequently the maximization of *Wealth*, is central to the economic evolvement of a society. In contrast, the paper implicitly supports that economic growth is an additional agent that, in conjunction with other independent variables like *Governance*, *Conflict* and *Mutuality*, explains the *order* of an economy.

The explicitation of such thesis is the construction of a multivariable equation in which GDP per capita, a component of the explanatory variable of *Wealth*, is not the dependent variable. The dependent variable denominated *Disentropy* accounts for the measure of *order* (lack of entropy) of an economic system. As a result of this novel scenario, the concept of *equilibrium* in the sense given by the classical and neo-walrasian economists based on demand, supply and price formation, is not consistent with the one derived from the model of economic order.

For the disentropic model, it is not a matter of achieving maximum growth but maximum order. In other words, the disentropic model pursues to explain the factors that determine the optimal distribution of resources and leveling of an economy. Under the above exposed hypotheses, aims and reasons the model fits into an out-of-equilibrium scenario (Arthur, 2005).

The disentropic model is process-dependent and organic; therefore, it falls within the sphere of evolutionary economics. The model is made up of the changing heterogeneous agents of *Governance*, *Wealth*, *Conflict* and *Mutuality* that interact sustainably with each other unfolding unpredictable patterns of growth and equilibrium.

2. A model of economic order

2.1. Disentropy: A measure of economic order

We define *order* as the condition of an economic system optimizing the possibilities frontier of interactions within and among the agents of *Governance*, *Wealth*, *Conflict* and *Mutuality*. These

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agents are denominated *economic optimizers* of the system. We intend to measure and evaluate the condition of *order* of a sample of countries of the world economy. We will do so by developing firstly a mathematical model that constitutes the theoretical framework, and secondly an empirical analysis that will allow us to establish a ranking of countries according to their level of economic order. The dependent or explained variable measuring order is an index called *Disentropy* δ whose values have a qualitative and ordinal sense.

In the *disentropic model* of economic order developed henceforth, the basic independent or explanatory variables are *Governance (G)*, *Wealth (W)*, *Conflict (C)* and *Mutuality (M)*. We intend to associate these variables to the dependent variable of *order* called *Disentropy (δ)* by appraising their respective individual contributions to order. The individual contribution to *order* of each variable is a function of its transactional capacity that we denominate *Transactionality*.

The *Disentropy* function adopts the form:

$$\delta = \delta\ (v_1, \ldots, v_N) \qquad (1)$$

where v_i (i = 1….N) are the variables or *agents* of order, namely, *Governance*, *Conflict*, *Wealth*, *Mutuality*, *Entrepreneurship*, *Innovation*, *Education* and *Network Configuration*. Each of these components constitutes an agent of economic order.

2.2. Transactionality

Transactionality – the capacity of an agent or variable to transact - refers to the variable that measures the exchange facilitation properties of the agents of *Governance*, *Wealth*, *Conflict* and *Mutuality* contributing to the attainment of *economic order*. The approach made in order to tackle this matter leaves the creation of wealth to a secondary role breaking with previous assumptions made by conventional economic theory in regard to the central role played by income and price formation mechanisms in economic processes.

A contract requires the intervention of at least two individuals. Similarly in the disentropic model a transaction happens between two or more individuals, and never between inanimate elements nor between individuals and inanimate elements. Instead transactions occur between individuals *via* inanimate elements (contracts, technology) that are the substratum or enablers of the transactions.

A *disentropic* (order) *function* δ in which all order agents v_i have an independent behavior, that's to say, in which there is not a trade-off between the explanatory variables, adopts the following representation:

$$\delta = \frac{1}{N}\sum_{i=1}^{N} v_i\ (t) \qquad (2)$$

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The behaviors of variables v_i: *Governance* (v_1), *Wealth* (v_2), *Conflict* (v_3) and *Mutuality* (v_4) are dependent on *Transactionality* (t).

Institutions fulfill an economic function by reducing transactions costs (Coase, 1937) and therefore ought to be treated as endogenous variables (Dahlman, 1979). Besides, any system of contract law has the purpose of facilitating exchange (Macneil, 1974). Therefore a good *Governance* framework does generate *order* under suitable contractual relations between individuals and proper institutions monitoring the transactions inherent to such contracts.

As for the *Wealth* order agent, *Transactionality* resides on the capacity of the economic system and society to make *Wealth* flow-through, and at the same time to be rightfully distributed preventing inequality. *Trading* configuration attributes included within this variable like internationalization, globalization and reduction of protectionist commercial barriers are facilitator agents of exchange and openness of the economy.

Conflict itself is the result of insufficient and inadequate contractual relations and institutions, determining involuntary exchange transactions that we qualify as *poor quality* or disrupting if they break the voluntary exchange premise.

Transactionality is inherent to the *Mutuality* order agent as this variable picks up exchange enforcement as result of technological development, property rights implementation, collaborationism and open innovation.

Ideally the *Disentropy* function, similarly to the utility function, complies with the Pareto optimality condition:

$$\partial \delta / \partial v_i > 0 \tag{3}$$

On the other hand, v_i is a function of *Transactionality* t:

$$v_i = f(t) \tag{4}$$

Higher transacionality implies more economic order. Therefore:

$$\partial v / \partial t > 0 \tag{5}$$

A small value of the variable *Governance* v_1 would explain for instance the lack of transactional flow arising under dictatorial regimes.

Whereas democracy is a political scenario that presents a high level of *Transactionality*, authoritarian systems are characterized by the *isolation* of the population suffering from a situation of unidirectional coercion by the oppressors (low or non-existent *Transactionality*).

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The variable *Conflict* v_2 picks up the transactional flow among individuals in the course of the socioeconomic interaction. Herein we will refer to human interaction in a broad sense (political, mercantile and civil). If *Transactionality t* is inexistent or scant, it leads to disorder, states of corruption, terrorism and war.

The transactional attributes of the variable *Mutuality* v_3 are related to the diffusion of technology as a tool to enhance mutual exchange among the different economic order agents.

If we consider the particular case of the variable *Wealth* v_4, understood as the measure of the wealth of an economy, *Transactionality* lies on the openness of that economy and therefore on its capacity to transact both in domestic and international markets. That's to say, *Transactionality* is determined by the ability of an economy to interact and trade globally.

Let's deepen into the *Transactionality* variable:

$$t = f\,(x_k) \qquad (6)$$

Transactionality t is a function of the number of transactions and exchanges between the immediate parties x_k in order to provide a good *order* and workable arrangements (Williamson, 2005). The variable x_k picks up the behavior ascendancy of the individual k-th.

In the disentropic model the *human behavior* angle of *utility* and *preference* of individuals, constitutes an *exogenous* variable, whilst *Governance*, *Wealth*, *Conflict* and *Mutuality* and the dependent variable of *order* itself, are all *endogenous* variables. Therefore x_k shown in (6) is an *exogenous* variable which is not explained by the model.

On the contrary, in the utilitarian theory, human behavior - restricted to its utility and preference dimension - is and *endogenous* variable. Besides, due to the fact that human freedom is an attribute of individuals, a set of behaviours inherent to all human beings are a given datum of the model. Some of these behaviours are *worth* (honesty, solidarity) and others are *contemptible* (corruption, cruelty). The endogenization of human behavior in classic and neoclassic economic theories, in the sense explained above, implies that the end of economic systems is fulfilling the satisfaction of individuals in order to achieve the highest social welfare and maximum income growth. Consequently, the conventional approach of economic theory up to the present time has consisted on pursuing social welfare via economic growth, as evidenced by historic economic data unveiling a more than exponential growth of the world GDP per capita (Maddison, 2001, 2003). The two mathematical axes of the models of *social welfare* and *economic growth* are the *utility function* and the *production function* respectively.

Differently from utilitarian theory, the disentropic model considers that the human behavior ascendancy of individuals x_k constitutes an external agent which is not a controllable variable.

The W curve of the social welfare and utility models is concave[4]. Hence, the welfare social function W increases with greater income, although the increase rate – the slope of the function -

4. Welfare functions adopt the Bergson-Samuelson form: W =W (u_1, ...,u_h) where i-th are the individuals, and the utility functions u_i represent the preferences of those individuals.

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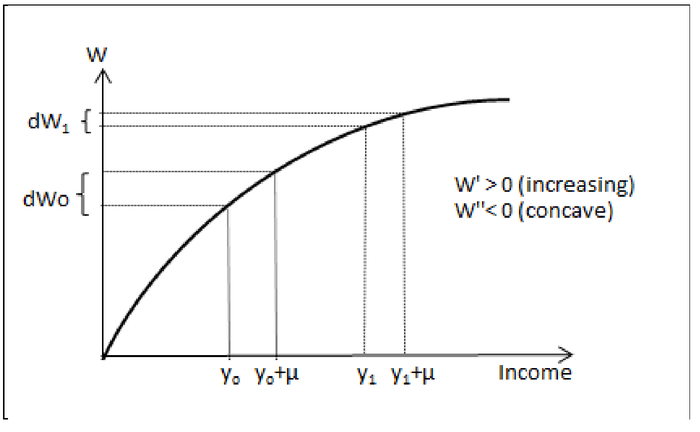
declines along the curve as shown in Figure 1. The interpretation of the concavity property is that increases at lower levels of income determine further welfare than the same increases at higher income levels.

Figure 1. Concavity of the Welfare function



Source: own elaboration based on Bellú and Liberati (2005).

Analogously, the assessment of the concavity or convexity of the disentropic model will require a specific analysis throughout the paper. Our research intends to find out whether the function of *Disentropy* δ is concave or convex along a cross-sectional sample of economies for the sake of determining whether *the order of an economic system increases or decreases as it evolves over time*.

The current paper restricts its analysis to a cross-sectional sample of 142 countries at a specific moment in time (2010-11). Therefore, at this point of the research we will not make a study of temporary series of the *Disentropy*. However, we will analyze the concavity or convexity of the *Disentropy* within the considered cross- sectional sample of countries.

2.3. Transactional elasticity and isolation aversion

The responsiveness of order δ to the changes in *Transactionality t* is the *transactional elasticity e* of the disentropic model.

$$e = \partial \delta / \partial t \qquad (7)$$

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Then an extended mathematical expression[5] of the *Disentropy* function exhibited in (1) is developed as follows:

$$\delta = \frac{1}{N}\left(\frac{1}{1-e}\sum_{i=1}^{N} v_i^{1-e}\right) \quad (8)$$

When e ⟶ 0 the elasticity *transaction to order* tends to zero and we get the expression (2) in which there is not a trade-off among the different order agents v_i.

$$\delta = \frac{1}{N}\sum_{i=1}^{N} v_i\,(t) \quad (2)$$

This is a situation of transactional *isolation* between the different agents of order v_i.

We will see later that a situation of *isolation aversion* appears when e ⟶ ∞ and there is a high transactional flow across the disentropic variables v_i .

Let's consider the i-th addend of the sum (8) and analyze δ when e ⟶1

$$\lim_{e\to 1} v_i = \lim_{e\to 1}\frac{v_i^{1-e}}{1-e} = \lim_{e\to 1}\frac{(l_n\, v_i)\ v_i^{1-e}}{-1}\,(-1) = l_n\,(v_i) \quad (9)$$

that makes (8), in this particular case, adopt the form:

$$\delta = \sum_{i=1}^{N} l_n\ (v_i) = l_n\ \prod_{i=1}^{N} v_i \quad (10)$$

When e ⟶ ∞ the *Disentropy* function of order is sensible to minimum variations of the individual v_i agents and such variation has an effect all across the independent variables of the function. Therefore, an increase of order in one of the agents v_i is transmitted immediately and pervasively to the rest of the variables. This effect is denominated *isolation aversion* and its mathematical representation is parallel to the one used in utilitarian theory (the rawlsian social welfare function) to express an infinite *inequality aversion*:

$$\delta = \min v_i \quad (11)$$

For reasons of simplicity, in the mathematical development of the disentropic model we assume that e = 0 and express equation (2) as a multivariate linear regression:

$$\delta = \beta_0 + \beta_1 \cdot v_1 + \ldots + \beta_i \cdot v_i + \varepsilon \quad (12)$$

5. Social welfare theory is the basis of the mathematical development of the Disentropy model. We refer to the theoretical notes on social welfare by Wada (2012).

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where *Disentropy* (δ) is the explained variable, the order agents v_i are the explanatory variables, β_i are the regression coefficients and ε is the error term.

2.4. Transformation of the Disentropy equation into a Cobb-Douglas analogous function

Next is a *Disentropy* δ_j mathematical model based on equation (12) where the independent variables or order agents are *Governance* (G_i), *Wealth* (W_i), *Conflict* (C_i) and *Mutuality* (M_i):

$$\delta_j = \beta_0 + \beta_1 \cdot G_j + \beta_2 \cdot W_j + \beta_3 \cdot C_j + \beta_4 \cdot M_j \qquad (13)$$

and "j" are the elements (countries) of the sample we are analysing. δ_j are the *Disentropy* (order) output levels of each element (country) "j".

In general for all "j" we can rewrite:

$$\delta = \beta_0 + \beta_1 \cdot G + \beta_2 \cdot W + \beta_3 \cdot C + \beta_4 \cdot M \qquad (14)$$

or what is the same,:

$$\delta = F\,(G, W, C, M) \qquad (15)$$

In practice, the sum of the order agents G, W, C and M gives an adjusted *Disentropy* level which can be higher or lower in value compared to the sum of the individual agents considered as independent order contributors. Thus there might be either a synergic or undermining effect as result of the interrelation between the different order agents. The concept of *isolation aversion* introduced previously refers to the particular case in which there is a high interaction between the order agents. The adjusting effect, amplifier or reducer of the *Disentropy* output, is introduced in equation (16) by incorporating a *Disentropy* adjustment coefficient θ.

Let´s define the following coefficients: θ = Disentropy adjustment coefficient; g = governance order rate; w = wealth order rate; c = conflict order rate; and m = mutuality order rate, we can write:

$$\theta \cdot F(G, W, C, M) = g \cdot G + w \cdot W + c \cdot C + m \cdot M \qquad (16)$$

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The *Disentropy* adjustment coefficient θ times the function of G, W, C and M is likely to be greater than the sum of the individual order agent contributions, although not necessarily. Then, we intend to maximize the *Disentropy* output, that's to say:

MAX: θ · F(G, W, C, M) – g · G – w · W – c · C – m · M (17)

Let G^*, W^*, C^*, M^* maximize the *Disentropy* output.

The first order conditions for an interior maximum are:

$$\theta \cdot F_G(G^*, W^*, C^*, M^*) = g \quad (18)$$

$$\theta \cdot F_W(G^*, W^*, C^*, M^*) = w \quad (19)$$

$$\theta \cdot F_C(G^*, W^*, C^*, M^*) = c \quad (20)$$

$$\theta \cdot F_M(G^*, W^*, C^*, M^*) = m \quad (21)$$

Where $F_G = \frac{\partial F}{\partial G}$, $F_W = \frac{\partial F}{\partial W}$, $F_C = \frac{\partial F}{\partial C}$ and $F_M = \frac{\partial F}{\partial M}$

Let's consider that the *fractions of order output* contributed by *Governance* (G), *Wealth* (W), *Conflict* (C) and *Mutuality* (M) are coefficients that adopt the following values respectively: α_1, α_2, α_3 and α_4. Then the expressions (18), (19), (20) and (21) can be written:

$$\alpha_1 \cdot \theta \cdot F(G^*, W^*, C^*, M^*) = g \cdot G^* \quad (22)$$

$$\alpha_2 \cdot \theta \cdot F(G^*, W^*, C^*, M^*) = w \cdot W^* \quad (23)$$

$$\alpha_3 \cdot \theta \cdot F(G^*, W^*, C^*, M^*) = c \cdot C^* \quad (24)$$

$$\alpha_4 \cdot \theta \cdot F(G^*, W^*, C^*, M^*) = m \cdot M^* \quad (25)$$

Dividing (19) by (22):

$$\frac{1}{G^*} = \frac{F_G(G^*,W^*,C^*,M^*)}{\alpha_1 F(G^*,W^*,C^*,M^*)} \quad (26)$$

Using the chain rule[6] in equation (26):

$$\frac{\partial l_n F}{\partial G} = \frac{F_G}{F} = \frac{\alpha_1}{G^*} \quad (27)$$

Expression (27) holds for every (G^*, W^*, C^*, M^*) that result in a disentropic output maximum.

Let's define $f_1(G) = l_n F$ as a function of G. Then, we rewrite (27) using ordinary derivative terminology:

$$\frac{df_1}{dG} = \frac{\alpha_1}{G} \quad (28)$$

That rearranged becomes:

$$df_1 = \frac{\alpha_1}{G}\, dG \quad (29)$$

Similarly,

$$\frac{\partial l_n F}{\partial W} = \frac{F_W}{F} = \frac{\alpha_2}{W^*} \quad (30)$$

$$\frac{\partial l_n F}{\partial C} = \frac{F_C}{F} = \frac{\alpha_3}{C^*} \quad (31)$$

$$\frac{\partial l_n F}{\partial M} = \frac{F_M}{F} = \frac{\alpha_4}{M^*} \quad (32)$$

Expressions (30), (31) and (32) also hold for every (G^*, W^*, C^*, M^*) resulting in disentropic output maximums.

Let's define $f_2(W) = l_n F$, $f_3(C) = l_n F$ and $f_4(M) = l_n F$ as functions of the variables W, C and M respectively. Using again ordinary differentiation notation:

6. The chain rule states that $\frac{dl_n f(x)}{dx} = \frac{f^{'}(x)}{f(x)}$. Therefore, $\frac{dl_n x}{dx} = \frac{1}{x}$

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$$\frac{df_2}{dW} = \frac{\alpha_2}{W} \quad (33)$$

$$\frac{df_3}{dC} = \frac{\alpha_3}{C} \quad (34)$$

$$\frac{df_4}{dM} = \frac{\alpha_4}{M} \quad (35)$$

and rearranging the terms of each equation:

$$df_2 = \frac{\alpha_2}{W} dW \quad (36)$$

$$df_3 = \frac{\alpha_3}{C} dC \quad (37)$$

$$df_4 = \frac{\alpha_4}{M} dM \quad (38)$$

If we treat equations (29), (36), (37) and (38) as a system of partial differential equations:

$$df_1 = \frac{\alpha_1}{G} dG \quad (29)$$

$$df_2 = \frac{\alpha_2}{W} dW \quad (36)$$

$$df_3 = \frac{\alpha_3}{C} dC \quad (37)$$

$$df_4 = \frac{\alpha_4}{M} dM \quad (38)$$

we can solve it as follows:

First, as f_1 depends on G, integrating both sides of equation (29):

$$l_n F = \alpha_1 \cdot l_n|G| + f_2\,(W) + f_3\,(C) + f_4\,(M) + k_1 \quad (39)$$

Where f_2, f_3 and f_4 are constants of integration that depend on W, C and M respectively. Integrating (36), (37) and (38):

f_2 *(W)=* $\alpha_2 \cdot l_n|W|$+k_2 (40)

f_3 *(C)=* $\alpha_3 \cdot l_n|C|$+k_3 (41)

f_4 *(M)=* $\alpha_4 \cdot l_n|M|$+k_4 (42)

Plugging (40), (41) and (42) into (39):

$$\begin{aligned} l_nF &= \alpha_1 \cdot l_n|G| + \alpha_2 \cdot l_n|W| + \alpha_3 \cdot l_n|C| + \alpha_4 \cdot l_n|M| + k_1 + k_2 + k_3 + k_4 \\ &= l_n|G|^{\alpha_1} + l_n\,|W|^{\alpha_2} + l_n|C|^{\alpha_3} + l_n|M|^{\alpha_4} + k \end{aligned} \quad (43)$$

Exponentiating both sides of equation (43):

$$\begin{aligned} e^{\ln F} &= e^{l_n|G|^{\alpha_1} + l_n\,|W|^{\alpha_2} + l_n|C|^{\alpha_3} + l_n|M|^{\alpha_4} + k} \\ &= e^{l_n|G|^{\alpha_1}} \cdot e^{l_n\,|W|^{\alpha_2}} \cdot e^{l_n|C|^{\alpha_3}} \cdot e^{l_n|M|^{\alpha_4}} \cdot e^{k} \end{aligned} \quad (44)$$

Finally a *Cobb-Douglas analogous equation* is obtained:

$$F = K \cdot G^{\alpha_1} \cdot W^{\alpha_2} \cdot C^{\alpha_3} \cdot M^{\alpha_4} \quad (45)$$

Where α_1, α_2, α_3 and α_4 are the fractions of order output contributed by each of the considered order agents G, W, C and M. Unlike the original Cobb-Douglas function

$$F = K \cdot G^{\alpha_1} \cdot W^{\alpha_2} \cdot C^{\alpha_3} \cdot M^{1-\alpha_1-\alpha_2-\alpha_3} \quad (46)$$

that complies with the following restrictions:

$$\alpha_4 = 1 - \alpha_1 - \alpha_2 - \alpha_3 \quad (47)$$

$$0 \le \alpha_i \le 1 \quad (48)$$

The *Disentropy Cobb-Douglas analogous function* does not present any restriction on the values of α_i:

$$-\infty \leq \alpha_i \leq +\infty \tag{49}$$

The sum of fractions of order output α_i can be less, equal or greater than zero accounting for the *adjusting* effect resulting from the combination of the different order factors G, W, C and M. This assumption allows us to consider that the values of α_i pick up the adjustment role of the constant K in equation (45). Therefore, we make K=1 and set the final *Disentropy* equation as follows:

$$F(G,W,C,M) = G^{\alpha_1} \cdot W^{\alpha_2} \cdot C^{\alpha_3} \cdot M^{\alpha_4} \tag{50}$$

2.5. Disentropy function concavity

In order to analyze the concavity or convexity of this function we need to obtain the determinant H of its hessian matrix and find out whether it is greater, minor or equal to zero[7]:

$$H = \det \begin{pmatrix} \frac{\partial^2 F(G,W,C,M)}{\partial G^2} & \frac{\partial^2 F(G,W,C,M)}{\partial G \partial W} & \frac{\partial^2 F(G,W,C,M)}{\partial G \partial C} & \frac{\partial^2 F(G,W,C,M)}{\partial G \partial M} \\ \frac{\partial^2 F(G,W,C,M)}{\partial W \partial G} & \frac{\partial^2 F(G,W,C,M)}{\partial W^2} & \frac{\partial^2 F(G,W,C,M)}{\partial W \partial C} & \frac{\partial^2 F(G,W,C,M)}{\partial W \partial M} \\ \frac{\partial^2 F(G,W,C,M)}{\partial C \partial G} & \frac{\partial^2 F(G,W,C,M)}{\partial C \partial W} & \frac{\partial^2 F(G,W,C,M)}{\partial C^2} & \frac{\partial^2 F(G,W,C,M)}{\partial C \partial M} \\ \frac{\partial^2 F(G,W,C,M)}{\partial M \partial G} & \frac{\partial^2 F(G,W,C,M)}{\partial M \partial W} & \frac{\partial^2 F(G,W,C,M)}{\partial M \partial C} & \frac{\partial^2 F(G,W,C,M)}{\partial M^2} \end{pmatrix} \tag{51}$$

The theoretical algebraic development necessary to calculate the hessian matrix (51) is formulated in Annex 1.

Due to the fact that there are not restrictions on the values of α_i and that as we will see later in the empirical development, the values of G,W,C and M are greater than zero, alternatively to the hessian analysis, concavity can also be determined by calculating the sum of α_i. If $\sum_{i=1}^{4} \boldsymbol{\alpha_i} > 0$ the Cobb-Douglas analogous function would present increasing *outputs of order* to scale, that's to say, the function would be *convex*. This reasoning is parallel to the one of increasing *returns* to scale in production theory (Cobb and Douglas, 1928).

7. Let *F* be a function of many variables with continuous partial derivatives of first and second order on the convex open set *S* and denote the Hessian of *F* at the point *x* by *H*(*x*). Then: (1) *F* is *concave* if and only if *H*(*x*) is negative semidefinite for all *x* ∈ *S; (2)* if *H*(*x*) is negative definite for all *x* ∈ *S* then *F* is *strictly concave; (3) F* is *convex* if and only if *H*(*x*) is positive semidefinite for all *x* ∈ *S;* and (4) if *H*(*x*) is positive definite for all *x* ∈ *S* then *F* is *strictly convex*.

Analogously, if $\sum_{i=1}^{4} \boldsymbol{\alpha}_i < 0$ the Cobb-Douglas analogous function would present decreasing outputs of order to scale (concavity), and in case that $\sum_{i=1}^{4} \boldsymbol{\alpha}_i = 0$ the function would present constant outputs of order to scale.

3. Empirical analysis

In this section an empirical validation of the model[8] is conducted using a database composed of values for nineteen variables (Table 1) relative to 142 countries of the world economy extracted from World Economic Forum (2011), International Telecommunication Union (2011) and International Monetary Fund (2011).

Firsty the information is reduced by running a principal components analysis (PCA) that determines the four economic optimizers of *Governance*, *Wealth*, *Conflict* and *Mutuality*. Then a cluster analysis is performed giving rise to four groups of countries sorted by increasing degree of *Economic Order*. The obtained clusters are labelled as *Queuers*, *Laggards*, *Medials* and *Toppers* respectively.

Secondly a logistic regression is constructed where the dependent variable of *Disentropy (*δ) is our proposed measure of economic order and the explanatory vatiables are the dimensions of *Governance*, *Wealth*, *Conflict* and *Mutuality*. The variable of *Disentropy (*δ) is a binary variable that takes the value of 1 when an economy exhibits a condition of economic order (absence of entropy), and the value of 0 when the economy is disordered (maximum entropy).[9] The allocation of countries to the condition of order (δ = 1) or disorder (δ = 0) is made based on the cluster analysis results. A country is in a situation of economic order when implicitly gathers the attributes of wealth, social welfare and equality. We assume that countries belonging to the *Queuers* and *Laggards* group are in a situation of economic disorder (δ = 0) and those belonging to the *Medials* and *Toppers* groups comply with the conditions of economic order (δ = 1). The obtained logit regression equation has a satisfactory goodness-of-fit as confirmed by Hosmer-Lemeshow, Pearson and Pseudo-R^2 tests. The resulting values of the dependent variable of disentropy for the 142 analyzed countries allows us to set a ranking of economies based on their increasing measure of economic order.

Lastly an Ordinary Least Squares (OLS) regression model is created and transformed into an analogous Cobb-Douglas equation that enables the study of the concavity of the variable of economic order.

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8 Statistical analyses have been conducted with Minitab 16 and SPSS 19 softwares.

9 Analogously, in medical research, *logit* regressions representing *health* or *disease occurrence* are built so that the dependent variables adopt the value of 1 in case of *death* or *disease occurrence* and the value of 0 in case of *alive* or *disease non- occurrence* (Weinblatt *et al.*, 1973; Walker and Duncan, 1967).

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Table 1. Independent variables – Order output drivers

Name	Short description	Extended description	Scale	Range	Min	Max	Mean	Std. Dev
GDPCAP	GDP per capita	Gross domestic product per capita in current US dollars	Continuous		180	108,832	14,574	19,306
INSPRORI	Property Rights	Measure of the protection of property rights, including financial assets	Discrete	*1 = very weak; 7 = very strong*	1.7	6.4	4.3	1.0
INSPROPRO	Property protection	Intellectual property protection, including anti-counterfeiting measures	Discrete	*1 = very weak 7 = very strong*	1.6	6.2	3.7	1.2
TECHCELLSUS	Mobile diffusion	Mobile cellular subscriptions per 100 inhabitants	Percentage		7.9	190.2	98.0	38.8
TECHAVLAT	Tech availability	Measure of the extent of availability of latest technology	Discrete	*1 = not available 7 = widely available*	3.1	6.9	5.0	0.9
TECHFIRMABS	Firm tech absorption	Extent of new technology absorption at business level	Discrete	*1 = not at all 7 = aggressive absorption*	3.2	6.5	4.8	0.7
TECHFAVDEC	Favoritism government	Extent to which government officials show favoritism to well-connected firms and individuals when deciding upon policies and contracts	Discrete	*1 = always show favoritism 7 = never show favoritism*	1.7	5.8	3.2	0.9
INSTWASPEN	Wastefulness government spending	Measure of the composition of public spending in the country	Discrete	*1 = extremely wasteful 7 = highly efficient in providing necessary goods and services*	1.7	6.1	3.3	0.9

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Name	Short description	Extended description	Scale	Range	Min	Max	Mean	Std. Dev
INSTBUREG	Burden government regulation	Measure of burdensome for businesses to comply with governmental administrative requirements	Discrete	*1 = extremely burdensome* *7 = not burdensome at all*	2.0	5.6	3.3	0.7
TECHTRANSF	FDI & Technology transfer	Extent of new technology contributed by foreign direct investment (FDI)	Discrete	*1 = not at all* *7 = FDI is a key source of new technology*	2.7	6.4	4.6	0.7
TECHBROADIN	Broadband internet diffusion	Number of fixed broadband Internet subscriptions per 100 population	Percentage		0.0	38.2	9.9	11.3
TECHINBAND	Internet bandwidth	International Internet bandwidth (kb/s)/capita	Continuous		0.0	474.3	22.6	55.2
EFLEGSEDIS	Legal framework private business	Measure of the efficiency of the legal framework for private businesses in settling disputes	Discrete	*1 = extremely inefficient* *7 = highly efficient*	1.9	6.3	3.8	1.0
EFLEGREG	Legal framework government	Measure of the efficiency of the legal framework for private businesses in challenging the legality of government actions and/or regulations	Discrete	*1 = extremely inefficient* *7 = highly efficient*	1.6	5.7	3.6	0.9

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Name	Short description	Extended description	Scale	Range	Min	Max	Mean	Std. Dev
TRANSPOLMAK	Transparency policymaking	Measure of the ease for businesses to obtain information about changes in government policies and regulations affecting their activities	Discrete	*1 = impossible* *7 = extremely easy*	2.2	6.3	4.3	0.7
BUCOTE	Terrorism	Measure of the extent of costs imposed by the threat of terrorism on businesses	Discrete	*1 = great* *7 = not at all*	2.9	6.8	5.4	0.8
BUCOCRIVI	Crime & Violence	Measure of the extent of costs imposed by the incidence of crime and violence on businesses	Discrete	*1 = great* *7 = not at all*	1.7	6.6	4.7	1.1
ORGACRI	Organized crime	Measure of the extent of costs imposed by organized crime (mafia-oriented racketeering, extortion) non businesses	Discrete	*1 = great* *7 = not at all*	1.9	6.8	5.1	1.1
REPOLSE	Police reliability	Measure of the reliability of police services to enforce law and order	Discrete	*1 = cannot be relied upon at all* *7 = can be completely relied upon*	2.0	6.7	4.3	1.2

Source: Own elaboration.

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3.1. Factorial analysis

A factorial analysis is performed over the independent variables defined in Table 1 in order to reduce the number of variables from nineteen to four. We perform a principal components analysis (PCA) using a Varimax rotation andvalidate its overall significance running a sphericity test over the correlation matrix (see table 2).

Table 2. PCA correlation matrix and Bartlett and KMO tests

	Variable	1	2	3	4	5	6	7	8	9
1	GDPCAP									
2	INSPRORI	0.685 ***								
3	INSPROPRO	0.768 ***	0.929 ***							
4	TECHCELLSUS	0.428 ***	0.408 ***	0.409 ***						
5	TECHAVLAT	0.735 ***	0.828 ***	0.844 ***	0.538 ***					
6	TECHFIRMABS	0.701 ***	0.823 ***	0.830 ***	0.463 ***	0.937 ***				
7	TECHFAVDEC	0.643 ***	0.772 ***	0.810 ***	0.325 ***	0.636 ***	0.668 ***			
8	INSTWASPEN	0.465 ***	0.679 ***	0.701 ***	0.290 ***	0.497 ***	0.521 ***	0.841 ***		
9	INSTBUREG	0.208 **	0.434 ***	0.457 ***	0.127 *	0.279 ***	0.337 ***	0.634 ***	0.765 ***	
10	TECHTRANSF	0.432 ***	0.630 ***	0.621 ***	0.392 ***	0.695 ***	0.717 ***	0.535 ***	0.460 ***	0.351 ***
11	TECHBROADIN	0.793 ***	0.676 ***	0.743 ***	0.474 ***	0.788 ***	0.693 ***	0.545 ***	0.307 ***	0.083 *
12	TECHINBAND	0.520 ***	0.473 ***	0.524 ***	0.351 ***	0.519 ***	0.477 ***	0.426 ***	0.337 ***	0.268 ***
13	EFLEGSEDIS	0.623 ***	0.862 ***	0.869 ***	0.282 ***	0.691 ***	0.732 ***	0.863 ***	0.819 ***	0.645 ***
14	EFLEGREG	0.614 ***	0.860 ***	0.858 ***	0.293 ***	0.699 ***	0.718 ***	0.859 ***	0.791 ***	0.607 ***
15	TRANSPOLMAK	0.557 ***	0.783 ***	0.782 ***	0.417 ***	0.713 ***	0.701 ***	0.782 ***	0.722 ***	0.660 ***
16	BUCOTE	0.326 ***	0.392 ***	0.440 ***	0.362 ***	0.344 ***	0.313 ***	0.381 ***	0.302 ***	0.133 ***
17	BUCOCRIVI	0.526 ***	0.607 ***	0.628 ***	0.333 ***	0.445 ***	0.477 ***	0.645 ***	0.580 ***	0.390*
18	ORGACRI	0.516 ***	0.696 ***	0.694 ***	0.259 ***	0.483 ***	0.516 ***	0.650 ***	0.606 ***	0.415 ***
19	REPOLSE	0.704 ***	0.854 ***	0.863 ***	0.454 ***	0.742 ***	0.735 ***	0.836 ***	0.710 ***	0.475***
	Mean	*14.574*	*4.31*	*3.69*	*97.96*	*5.04*	*4.82*	*3.21*	*3.28*	*3.29*
	Std. Deviation	*19.306*	*1.05*	*1.16*	*38.82*	*0.90*	*0.75*	*0.92*	*0.92*	*0.68*

	Variable	10	11	12	13	14	15	16	17	18	19
11	TECHBROADIN	0.417 ***									
12	TECHINBAND	0.286 ***	0.629 ***								
13	EFLEGSEDIS	0.572 ***	0.511 ***	0.469 ***							
14	EFLEGREG	0.575 ***	0.539 ***	0.485 ***	0.962 ***						
15	TRANSPOLMAK	0.630 ***	0.556 ***	0.467 ***	0.826 ***	0.830 ***					
16	BUCOTE	0.285 ***	0.360 ***	0.257 ***	0.320 ***	0.312 ***	0.387 ***				
17	BUCOCRIVI	0.333 ***	0.514 ***	0.383 ***	0.549 ***	0.536 ***	0.540 ***	0.603 ***			
18	ORGACRI	0.370 ***	0.478 ***	0.367 ***	0.663 ***	0.620 ***	0.572 ***	0.587 ***	0.885 ***		
19	REPOLSE	0.580 ***	0.679 ***	0.486 ***	0.810 ***	0.796 ***	0.740 ***	0.485 ***	0.723 ***	0.733 ***	
	Mean	*4.57*	*9.93*	*22.60*	*3.77*	*3.64*	*4.30*	*5.43*	*4.65*	*5.09*	*4.29*
	Std. Deviation	*0.66*	*11.29*	*55.21*	*0.96*	*0.88*	*0.74*	*0.82*	*1.09*	*1.09*	*1.18*

Notes: N=142, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.5$. Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) = 0.917; Bartlett's test of Sphericity: Approximate Chi-Square = 3,421.83 (df = 171, p = 0.000)

Kaiser-Meyer-Olkin measure of sampling adequacy is 0.92 which is a great result indicating that the size of the sample is adequate to perform the factor analysis. On the other hand, the obtained measure of the Bartlett's test is highly significant (p = 0.000) corroborating that the factor analysis is appropriate.

The results and adopted factorization are shown in Table3.

Table 3 Varimax rotated factor matrix of economic optimizers Governance, Wealth, Conflict, and Mutuality

	Factor1	Factor2	Factor4	Factor3	
Variable	**Governance**	**Wealth**	**Conflict**	**Mutuality**	*Commonalities*
INSPRORI	0.580	-0.549	-0.258	-0.399	*0.863*
INSPROPRO	0.568	-0.612	-0.282	-0.368	*0.911*
TECHFAVDEC	0.757	-0.392	-0.294	-0.203	*0.855*
INSTWASPEN	0.861	-0.157	-0.262	-0.137	*0.854*
INSTBUREG	0.876	0.061	-0.088	-0.025	*0.780*
EFLEGSEDIS	0.811	-0.432	-0.169	-0.226	*0.923*
EFLEGREG	0.784	-0.454	-0.146	-0.240	*0.780*
TRANSPOLMAK	0.704	-0.335	-0.200	-0.407	*0.813*
REPOLSE	0.557	-0.504	-0.428	-0.328	*0.856*
GDPCAP	0.245	-0.773	-0.223	-0.263	*0.776*
TECHBROADIN	0.073	-0.850	-0.243	-0.321	*0.890*
TECHINBAND	0.185	-0.724	-0.131	-0.039	*0.577*
BUCOTE	0.058	-0.079	-0.832	-0.287	*0.783*
BUCOCRIVI	0.375	-0.319	-0.791	-0.052	*0.872*
ORGACRI	0.465	-0.324	-0.731	-0.046	*0.857*
TECHCELLSUS	-0.016	-0.210	-0.300	-0.699	*0.623*
TECHAVLAT	0.330	-0.636	-0.098	-0.633	*0.923*
TECHFIRMABS	0.411	-0.572	-0.091	-0.598	*0.862*
TECHTRANSF	0.424	-0.164	-0.043	-0.748	*0.767*
Variance	*5.74*	*4.48*	*2.67*	*2.80*	*15.686*
% Var	*0.30*	*0.24*	*0.14*	*0.15*	*0.826*

Source: Own elaboration.

Table 4 shows the allocation of the nineteen variables to the four factors or synthetic indices of *Governance* (G), *Wealth* (W), *Conflict* (C) and *Mutuality* (M). Most technological variables are included within the *Mutuality* factor as they constitute agents that enforce exchange. Property rights variables are allocated to the *Governance* factor due to the role of governments as property protection providers through the machinery of the state (Williamson, 2005).

Table 4. Variables allocation to synthetic indices

SYNTHETIC INDICES			
Factor1	**Factor2**	**Factor3**	**Factor4**
Governance	**Wealth**	**Conflict**	**Mutuality**
INSPRORI	GDPCAP	BUCOTE	TECHCELLSUS
INSPROPRO	TECHBROADIN	BUCOCRIVI	TECHAVLAT
TECHFAVDEC	TECHINBAND	ORGACRI	TECHFIRMABS
INSTWASPEN			TECHTRANSF
INSTBUREG			
EFLEGSEDIS			
EFLEGREG			
TRANSPOLMAK			
REPOLSE			

Source: Own elaboration.

Using the values of the nineteen dependent variables listed in Table 1 in the period 2010-2011 we obtain the values of the four synthetic indices for the 142 countries. The calculation of the indices is done by first *normalizing* and second *aggregating* the values of the nineteen variables into four factors. We haven't applied any factor weighting for the determination of the indices. The calculated indices of *Governance*, *Wealth*, *Conflict* and *Mutuality* for the sample of 142 countries are shown in Annex 2.

3.2. Cluster analysis

Performance of K-means cluster analysis gives a partition of the 142 countries into 4 clusters. Tables 5 and 6 exhibit the results of k-means and group centroids tests respectively.

Table 5. Results of k-means (quick cluster) analysis

	Number of observations	Within cluster sum of squares	Average distance from centroid	Maximum distance from centroid
Cluster 1	54	386.118	2.584	4.162
Cluster 2	50	478.516	2.973	5.441
Cluster 3	28	274.281	2.975	4.896
Cluster 4	10	85.575	2.678	5.364

Source: own elaboration.

Table 6. Group centroids

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	Queuers	**Laggards**	**Medials**	**Toppers**
GDPCAP	0.196	0.527	2.123	3.672
INSPRORI	3.369	4.354	5.418	6.070
INSPROPRO	2.670	3.618	5.021	5.830
TECHCELLSUS	2.813	3.780	4.356	4.907
TECHAVLAT	4.311	4.952	6.075	6.540
TECHFIRMABS	4.232	4.756	5.646	6.040
TECHFAVDEC	2.511	3.180	3.979	4.920
INSTWASPEN	2.678	3.348	3.807	4.760
INSTBUREG	3.026	3.304	3.489	4.150
TECHTRANSF	4.089	4.694	5.068	5.090
TECHBROADIN	0.462	1.210	4.005	6.069
TECHINBAND	0.045	0.106	0.489	2.593
EFLEGSEDIS	3.037	3.768	4.536	5.610
EFLEGREG	2.954	3.648	4.325	5.340
TRANSPOLMAK	3.776	4.280	4.868	5.660
BUCOTE	4.880	5.710	5.764	6.110
BUCOCRIVI	3.748	4.872	5.518	6.030
ORGACRI	4.159	5.310	5.996	6.530
REPOLSE	3.193	4.346	5.611	6.250
Centroid Average	*2.955*	*3.672*	*4.531*	*5.377*

Notes: Single linkage method. Euclidean distance measure. Standardized variables. Source: own elaboration.

The Centroid average in Table 6 provides a hypothetical measure of Order within each cluster. Thus clusters are denominated Queuers (cluster 1), Laggards (cluster 2), Medials (cluster 3) and Toppers (cluster 4), where higher values of the centroid average indicate a greater degree of Order (Topper countries) and lower values a minor degree of Order (Queuer countries).

Table 7 lists countries allocated to clusters that are sorted by increasing degree of *Order*.

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Table 7. Partition of the 142 countries into four clusters

Queuers	Laggards	Medials	Toppers
Lebanon	Namibia	United Kingdom	Finland
Iran, Islamic Rep	Malaysia	Canada	Switzerland
Swaziland	South Africa	Ireland	Singapore
Benin	Mauritius	France	Luxembourg
Jamaica	Jordan	Austria	Sweden
Burkina Faso	Botswana	Taiwan, China	Hong Kong SAR
Uganda	Rwanda	New Zealand	Denmark
Mexico	Gambia, The	Barbados	Norway
Colombia	Uruguay	Germany	Netherlands
Dominican Republic	China	Bahrain	Iceland
Peru	Kuwait	Japan	
Belize	Tunisia	Puerto Rico	
Cambodia	Panama	Saudi Arabia	
El Salvador	Montenegro	Australia	
Honduras	Syria	Oman	
Bangladesh	Brunei Darussalam	Cyprus	
Guyana	Poland	Belgium	
Kenya	Sri Lanka	Estonia	
Cameroon	Greece	Israel	
Philippines	Ethiopia	Malta	
Guatemala	Brazil	United States	
Kazakhstan	Morocco	Chile	
Mauritania	Lithuania	Spain	
Tanzania	Hungary	United Arab Emirates	
Mozambique	Costa Rica	Qatar	
Mali	India	Portugal	
Lesotho	Italy	Korea, Rep	
Pakistan	Turkey	Slovenia	
Yemen	Zambia		
Moldova	Latvia		
Mongolia	Egypt		
Bulgaria	Senegal		
Nicaragua	Czech Republic		
Nigeria	Slovak Republic		
Ecuador	Malawi		
Nepal	Ghana		
Côte d'Ivoire	Trinidad Tobago		
Serbia	Indonesia		
Algeria	Romania		
Paraguay	Croatia		
Bosnia Herzegovina	Azerbaijan		
Russian Federation	Cape Verde		
Madagascar	Tajikistan		
Timor-Leste	Armenia		
Argentina	Vietnam		
Angola	Macedonia, FYR		
Burundi	Suriname		
Bolivia	Thailand		
Ukraine	Albania		
Chad	Georgia		
Kyrgyz Republic			
Zimbabwe			
Haiti			
Venezuela			

Source: own elaboration.

3.3. Linear Logit Model. Disentropy Index (δ_a)

In order to determine the degree of economic order of each country we use Minitab 16 to run *a Logit* regression using a confidence interval of (1-α) = 95% - results depicted in Table 8 - where the *binary* dependent variable is called δ (*Disentropy index*). We establish that there is an hypothetical situation of economic order (δ = 1) for economies belonging to the clusters of *Topper* and *Medial* countries, and a situation of disorder (δ = 0) for economies belonging to the clusters of *Laggard* and *Queuer* countries. A highly entropic environment is the one characterized by poor governance practices, low GDP per capita, no technological diffusion and conflict profusion (crime, wars and terrorism). The four independent variables of the *logit* regression are the synthetic indices that we have denominated G, W, C and M.

The logit regression equation is built as follows:

$$\delta = \text{logit}\ (p) = \beta_0 + \beta_1 \cdot G + \beta_2 \cdot W + \beta_3 \cdot C + \beta_4 \cdot M + \varepsilon \qquad (52)$$

where the independent variable of *Disentropy* (δ) is equal to the logit transformation of the probability p, the dependent variables are the synthetic indices of *Governance* (G), *Wealth* (W), *Conflict* (C) and *Mutuality* (M), and the error term is represented by ε.

Table 8: Logistic Regression Table (Logit Model δ_a)

Predictor	Coef	SE Coef	Z	P	Odds ratio	CI of 95% lower limit
Constant	-85.48	27.72	-3.08	0.002		
Governance	1.28	0.64	2.00	0.045	3.61	1.03
Wealth	6.39	2.29	2.80	0.005	596.95	6.76
Conflict	7.26	2.51	2.90	0.004	1.426.49	10.45
Mutuality	6.19	2.26	2.74	0.006	485.87	5.82

Pearson Chi-Sq. = 23.30 (df = 137, p = 1.000)
Deviance Chi-Sq. = 22.86 (df = 137, p = 1.000)
Hosmer-Lemeshow Chi- Sq. = 0.21 (df = 8, p = 1.000)

Source: own elaboration.

To formulate the regression we use the unstandardized coefficients as firstly, there are not changes in the units of measurement of the dependent variables, which in fact do not have a unit of measure, and secondly, we look forward to determining coefficients that remain invariant among different populations enabling the description of the causal law that drives the dependent variable of disentropy (δ) (Blalock, 1967; Richards, 1982)

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Therefore, plugging the obtained values of the β coefficients into the generic equation (52) we get the logit equation:

$$\delta_a = -85.48 + 1.28 \cdot G + 6.39 \cdot W + 7.26 \cdot C + 6.19 \cdot M \quad (53)$$

The p values of the estimated coefficients of the dependent variables G, W, C, M and the constant β_0 are equal to 0.045, 0.005, 0.004, 0.006 and 0.002 respectively complying with the condition that $p < 0.05$; therefore, they are all significant to explain the dependent variable δ of disentropic growth.

With regard to Hosmer-Lemeshow test, its chi-square equal to 0.21 and p = 1.000 indicate that the model has a good goodness-of-fit. This is confirmed as well by Pearson test where chi-square equal to 23.30 and p = 1,000.

We double check the goodness-of-fit of the model by calculating its Pseudo-R^2:

$$\text{Pseudo-}R^2 = \frac{Log\ Likelihood_{FIRST\ STEP} - Log\ Likelihood_{LAST\ STEP}}{Log\ Likelihood_{FIRST\ STEP}} \quad (54)$$

Using the data shown in table 9 we obtain a pseudo R^2 = 88% which is fairly close to 100% indicating that de goodness of the fit is reasonable.

Table 9: Log-likelihood iteration (Logit Model δ_a)

Step	Log-likelihood
0	-94.32
1	-44.11
2	-31.07
3	-23.22
4	-16.56
5	-13.12
6	-11.81
7	-11.47
8	-11.43
9	-11.43
10	-11.43
11	-11.43

Source: own elaboration.

3.4. First Normalization of the Disentropy Index (δ_{n_a})

If we omit the constant $\beta_0 = -85.48$ of equation (53) we obtain a first *normalized Disentropy* index δ_{n_a} where *all values are greater than zero*. The significance of the new disentropic measure remains the same as in the previous equation δ_a:

$$\delta_{n_a} = 1.28 \cdot G + 6.39 \cdot W + 7.26 \cdot C + 6.19 \cdot M \qquad (55)$$

Annex 3 shows the values of δ_{n_a} for the 142 countries. The resulting ranking of the top ordered economies is exactly the same as the one derived from the disentropy index δ_a.

3.5. OLS Multilinear Regression Model. Disentropy Index (δ_b)

In order to study the *concavity* of the *Disentropy* index of economic order, we need to transform the obtained linear equation into a twice differentiable Cobb-Douglas analogous function that allows us to determine whether the determinant of the hessian matrix is less, equal or greater than zero. That's to say, we need to derive an equation of the form:

$$F(G, W, C, M) = G^{\alpha_1} \cdot W^{\alpha_2} \cdot C^{\alpha_3} \cdot M^{\alpha_4} \qquad (50)$$

To get to such an equation form, first we will run a multilinear regression (MLR) using ordinary least squares (OLS) as shown in (56), sourced on the values of the naperian logarithms of the variables for the 142 countries:

$$\delta_b = \alpha_0 + \alpha_1 \cdot \ln(G) + \alpha_2 \cdot \ln(W) + \alpha_3 \cdot \ln(C) + \alpha_4 \cdot \ln(M) + \varepsilon \qquad (56)$$

Next we will exponentiate the resulting equation to obtain the Cobb-Douglas form.

We set the values of the dependent variable of *Disentropy* δ_b as the naperian logarithms of δ_{n_a} obtained following the normalization of the logit linear regression (Annex 3).

We use Minitab 16 to determine the OLS multilinear regression where the independent variable is $\delta_b = \ln(\delta_{n_a})$ and the dependent variables are ln (G), ln (W), ln (C) and ln (M) (see Table 10).

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Table 10: OLS Multilinear Regression Table (δ_b)

Predictor	Coef	SE Coef	Z	P
Constant	4.09	0.08	54.51	0.000
ln G	0.55	0.04	12.96	0.000
ln W	0.06	0.01	11.30	0.000
ln C	0.17	0.03	6.25	0.000
ln M	0.20	0.06	3.32	0.001

Notes: S = 0.06; R-Sq. = 94.6%; R-Sq (adjusted) = 94.5%; Durbin-Watson = 1.759

The obtained OLS regression presents an acceptable goodness-of-fit as the Durbin-Watson statistic value of 1.759 is less than 2 and slightly higher than the dU critical value of 1.758 set for models with 4 regressors (excluding the intercept), 5% level of significance and over 100 observations.

Based on these results, we depict the OLS multilinear regression equation:

$$\delta_b = \ln\ (\delta_{n_a}) = 4.09 + 0.55 \cdot \ln G + 0.06 \cdot \ln W + 0.17 \cdot \ln C + 0.20 \cdot \ln M \qquad (57)$$

3.6. Second normalization of the Disentropy Index (δ_{n_b})

Next we normalize δ_b by omitting the constant:

$$\delta_{n_b} = 0.55 \cdot \ln G + 0.06 \cdot \ln W + 0.17 \cdot \ln C + 0.20 \cdot \ln M \qquad (58)$$

The use of logarithms in the second normalized index δ_{n_b} *pulls in* the residuals for the bigger values. The *Disentropy* country rankings of top ordered economies obtained for δ_{n_a} and δ_{n_b} are similar (see Annex 3), but in principle, results of δ_{n_b} are more uniform due to the fact that naperian logarithms minimize the distortion created by unusual high values.

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3.7. Disentropy Cobb-Douglas analogous function (δ_{CD})

Let's define a *Disentropy* index δ_{CD} that complies:

$$\delta_{n_b} = \ln \delta_{CD} \tag{59}$$

and plugging the value of δ_{n_b} into (58):

$$\begin{aligned} \ln \delta_{CD} &= 0.55 \cdot \ln G + 0.06 \cdot \ln W + 0.17 \cdot \ln C + 0.20 \cdot \ln M \\ &= l_n G^{0.55} + l_n W^{0.06} + l_n C^{0.17} + l_n M^{0.20} \end{aligned} \tag{60}$$

Exponentiating both sides of equation (60):

$$e^{\ln \delta_{CD}} = e^{l_n G^{0.55} + l_n W^{0.06} + l_n C^{0.17} + l_n M^{0.20}} \tag{61}$$

that finally adopts the Cobb-Douglas analogous function form:

$$\delta_{CD} = G^{0.55} \cdot W^{0.06} \cdot C^{0.17} \cdot M^{0.20} \tag{62}$$

The values of the disentropy index δ_{CD} for the 142 countries are displayed in Annex 3.

3.8. Concavity analysis of the Disentropy Cobb-Douglas analogous function (δ_{CD})

To determine whether the hessian of (62) is greater, minor or equal to zero and conclude on the concavity or convexity of the disentropic function, we will first make the assumption that

$$G = W = C = M \tag{63}$$

And we will denominate the only variable V:

$$V = G = W = C = M \tag{64}$$

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The values of G, W, C and M shown in Annex 2 are all greater than zero:

$$G, W, C, M > 0 \quad (65)$$

Therefore,

$$V > 0 \quad (66)$$

Restrictions (64) and (65) enable us to simplify the required complex algebraic development needed to calculate the hessian of function (62) (see annex 1). We rewrite (62) as an univariate function:

$$\delta_{CD} = V^{0.55+0.06+0.17+0.20} = V^{0.98} \quad (67)$$

The first derivative of δ_{CD} is $\delta_{CD}{}'$:

$$\delta'_{CD} = 0.98 \cdot V^{-0.02} \quad (68)$$

The second derivative of δ_{CD} is δ_{CD}'':

$$\delta''_{CD} = -1.96 \cdot 10^{-2} \times V^{-1.02} \quad (69)$$

Since V > 0 as defined in (66), then,

$$\delta_{CD}'' < 0 \quad (70)$$

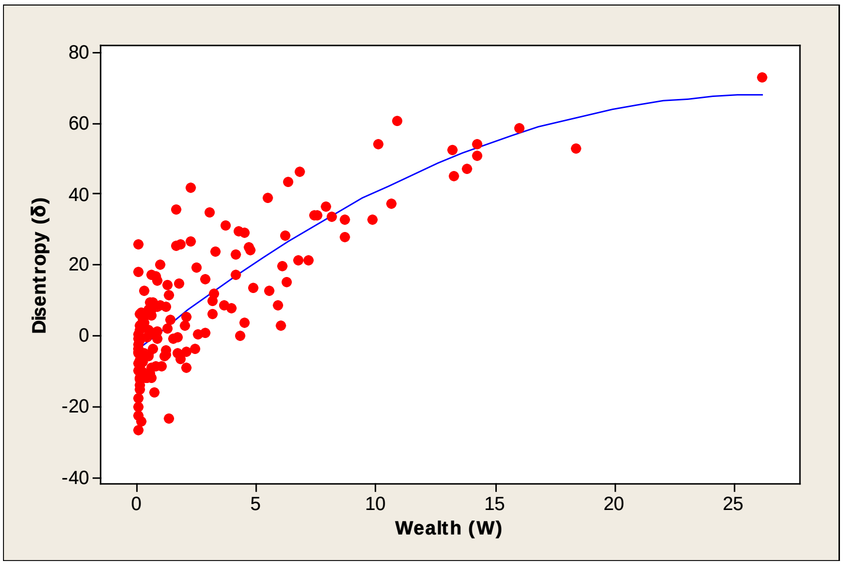
which allow us to conclude that the *Disentropy* index δ presents a *concave* behaviour across the analyzed sample of 142 countries. At a specific period of time, *order* across the different world economies presents *decreasing outputs to scale*. This means that the increase of *order* is reduced by more than a proportional change throughout the studied countries.

3.9. Discussion

We have built a logit regression making the assumption that the dependent variable of *Disentropy* adopts the value of 0 when an economy complies with the hypothetical condition of utmost *disorder*, and 1 when there is a condition of maximum *order*.

Figure 4 displays the scatter plot of the variable of *Disentropy* (δ) versus the independent variable of *Wealth* (W). The graph traces a *concave* curve as the second derivative of its adjusted line function is negative.

Figure 4. Disentropy vs Wealth



Notes: $\delta = -4.04 + 5.53 \cdot W - 0.11 \cdot W^2$; Pearson correlation = 0.810, p=0.000; S=11.37; R-Sq (adjusted) = 68.2%

Therefore, within the cross-sectional sample of economies of our analysis, as we move to higher levels of *Wealth* the increments of *Order* due to increases of *Wealth* get lower. This is an important outcome that means that as an economy evolves into a more *ordered* condition, *Wealth* becomes a less relevant order contributor to the economy.

Should we make the transposition of the curve *Disentropy* versus *Wealth* depicted in Figure 4, we obtain the curve *Wealth* versus *Disentropy* which is *convex* (Figure 5). Let's make the hypothesis that within the cross-sectional sample of countries under analysis the economies presenting a higher economic *order* are ahead in time with respect to the laggard ones. Then we represent the variable *time*, as well as the *Disentropy* variable, in the abscissa axis of Figure 5. The behavior of *Wealth* growing more than proportionally over time is consistent with historic data of the world GDP per capita growth (Maddison 2001, 2003) shown in Figure 6.

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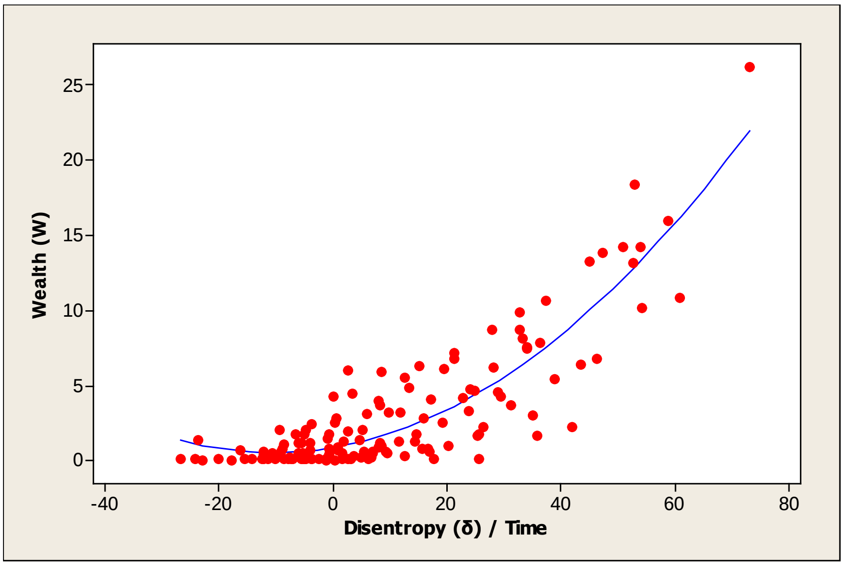
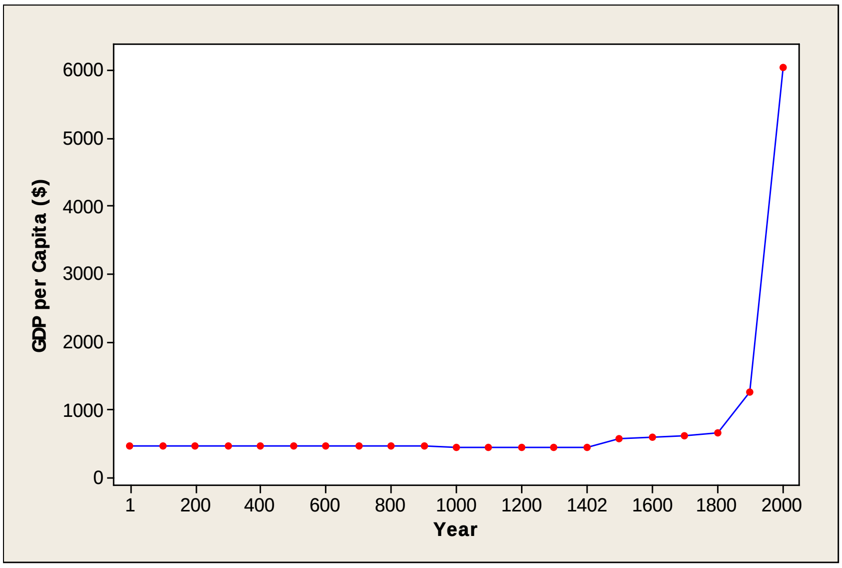
Figure 5. Wealth vs Disentropy



Notes: $W = 0.85 + 0{,}06 \cdot \delta + (0.31 \cdot 10^{-2}) \cdot \delta^2$; Pearson correlation = 0.810, p=0.000; S=2.00; R-Sq (adjusted) = 78.0%

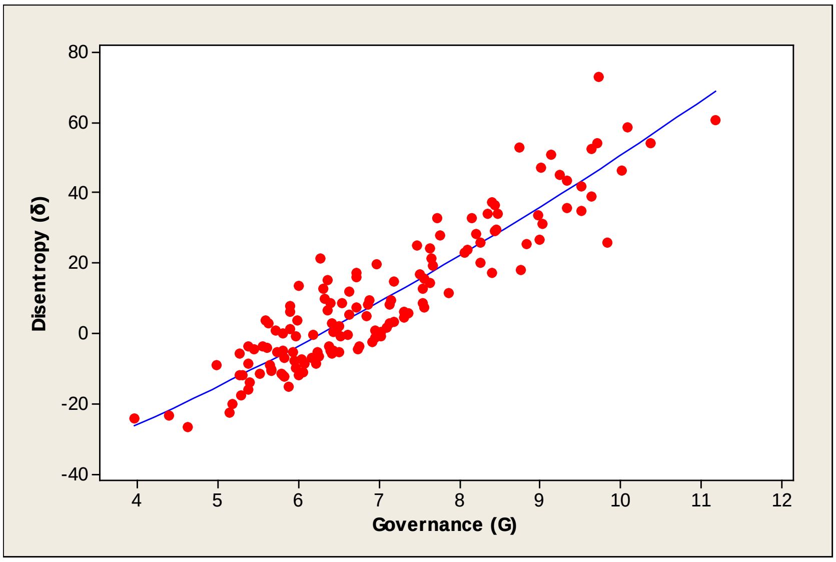
Figure 6. World GDP capita



Source: Own elaboration based on Maddison (2001, 2003).

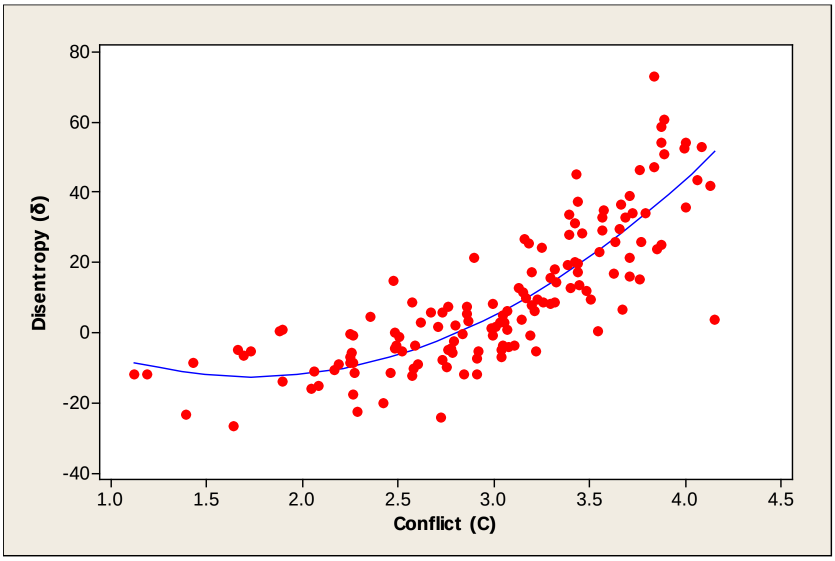
The scatter plots of *Disentropy* versus *Governance*, *Conflict* and *Mutuality* show strong correlations in all cases (Figures 7, 8 and 9). The obtained values of the coefficient of determination R-squared (adjusted) of 84.5%, 70.7% and 69.8% respectively confirm a suitable goodness-of-fit of the model.

Figure 7. Disentropy vs Governance



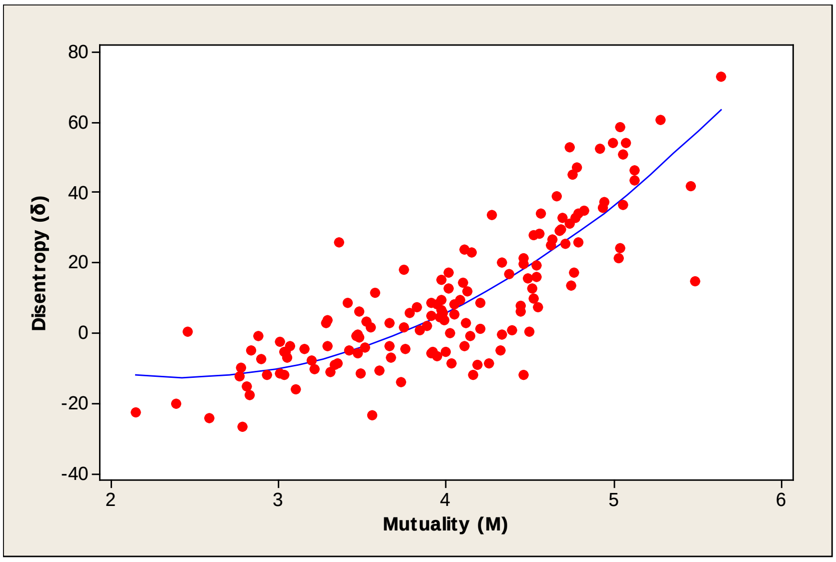
Notes. $\delta = -62.59 + 7.63 \cdot G - 0.37 \cdot G^2$; Pearson correlation = 0.918; p=0.000; S=7.00; R-Sq (adjusted) = 84.5%

Figure 8. Disentropy vs Conflict



Notes: $\delta = 20.23 - 38.09 \cdot C + 10.99 \cdot C^2$; Pearson correlation = 0.788, p=0.000; S=10.91; R-Sq (adjusted) = 70.7%

Figure 9. Disentropy vs Mutuality



Notes: $\delta = 30.06 - 35.41 \cdot M + 7.34 \cdot M^2$; Pearson correlation = 0.807; p=0.000; S=11.09; R-Sq (adjusted) = 69.8%

An economy is in *order* when it is provided with efficient governance practices, a suitable institutional framework, a leveled wealth distribution, a non-conflict environment and an advanced and pervasive technological development within all domains of society. The convergence of the above mentioned disparate characteristics of economic order - gathered by the four economic optimizers of *Governance*, *Conflict*, *Wealth* and *Mutuality* of our analysis - do not imply that the most egalitarian economies are the most ordered economies. On the contrary, the correlation between the Income Gini index[10] and the *Disentropy* index is low (Pearson correlation of -39.7%) (Figure 10).

The correlation between the Human Development Index (HDI)[11] and the *Disentropy* index shown in Figure 11 is higher (Pearson correlation of 66,2%) than the correlation between the Income Gini index and the *Disentropy* index depicted in Figure 10 (Pearson correlation of -39.7%). Hence, the Human Development Index (HDI) gives a broader measure of *economic order* than the Gini index as it takes into account, besides the statistic of Income, the statistics of Life Expectancy and Education in order to evaluate the development of an economy. Nevertheless, it only accounts for a limited view of *economic order* compared to the *Disentropy* index.

10. Gini index data are sourced on the Human Development Report of UNDP (2000-2010), and CIA World Fact Book (2009).

11. Human Development Index (HDI) data are sourced on the Human Development Report of UNDP (2010).

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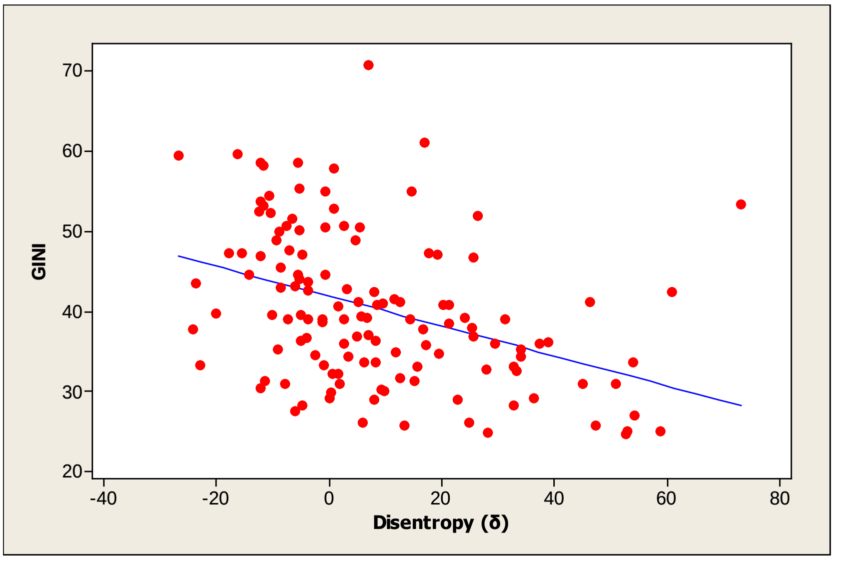
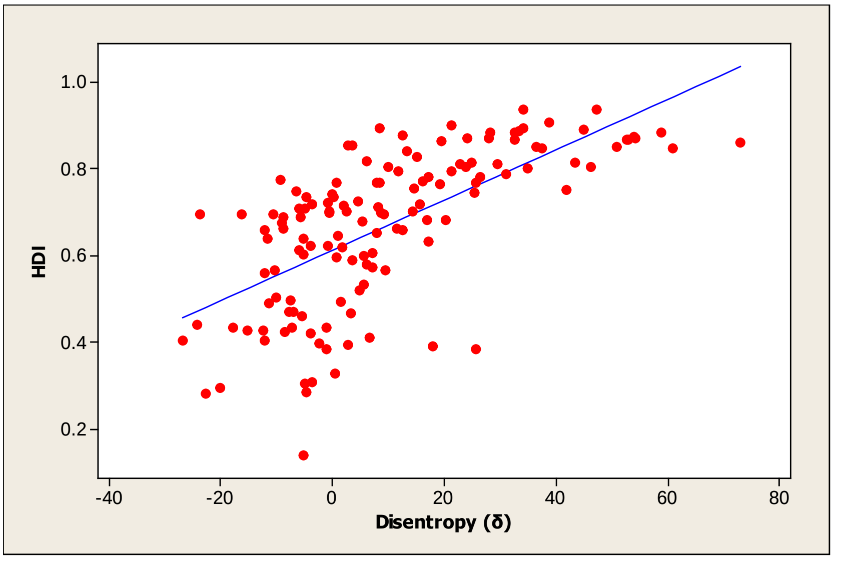
Figure 10. Disentropy vs Gini



Notes: GINI = 41.89 – 0.19 · δ ; Pearson correlation =- 0.397; p=0.000; S=8.74; R-Sq (adjusted) = 15.1%

Figure 11. Disentropy vs HDI



Notes: HDI = 0.61 + $(0.58 \cdot 10^{-2}) \cdot \delta$; Pearson correlation = 0,662; p=0.000; S=0.13; R-Sq (adjusted) = 43.9%

To summarize, the following outcomes are drawn from the above analyses:

1. Lower income *Inequality* (Gini) does not imply greater *Order*.
2. Greater *Human Development* (HDI) implies greater *Order*.
3. Greater *Wealth* implies greater *Order* (Disentropy) to a point where greater *Wealth* does not determine significant increases of *Order* (concavity property).

Next is the list of top 10 countries showing higher normalized *Disentropy* indices (Table 11):

Table 11: Top 10 *Ordered* economies of the world

Country	δ_{na}	Rank
Hong Kong SAR	158.58	1
Singapore	146.32	2
Sweden	144.25	3
Finland	139.71	4
Switzerland	139.40	5
Iceland	138.37	6
Denmark	138.03	7
Luxembourg	136.23	8
Norway	132.77	9
Qatar	131.72	10

Source: Own elaboration.

There are two Asian economies (Hong Kong SAR and Singapore), seven European countries (Sweden, Finland, Switzerland, Iceland, Denmark, Luxembourg an Norway) and one economy located in the Arabic region (Qatar) among the most ordered economies of the world. The seven European countries within the top ten *ordered* economies are located in the northern side of the continent. Three of them belong to the cultural-linguistic region of Scandinavia (Sweden, Denmark and Norway). Finland and Iceland although not Scandinavian strictly speaking, they are close to this political and societal construct. In fact, they belong to the so called Nordic countries together with the Scandinavian ones. Four out of the seven European countries are members of the European Union (Sweden, Finland, Denmark and Luxembourg).

Countries listed in the top ten *order* ranking probably have in common the following features:

- Economies are eminently *knowledge intensive*.
- *International* focus.
- *Populations* are small. In 2012 they fell within the range of Iceland 320 thousand inhabitants (ranked 176 of the world) and Netherlands 9.5 million (ranked 89)[12].

12. Population data sourced on the World Development Indicators database of the World Bank (17th December 2013).

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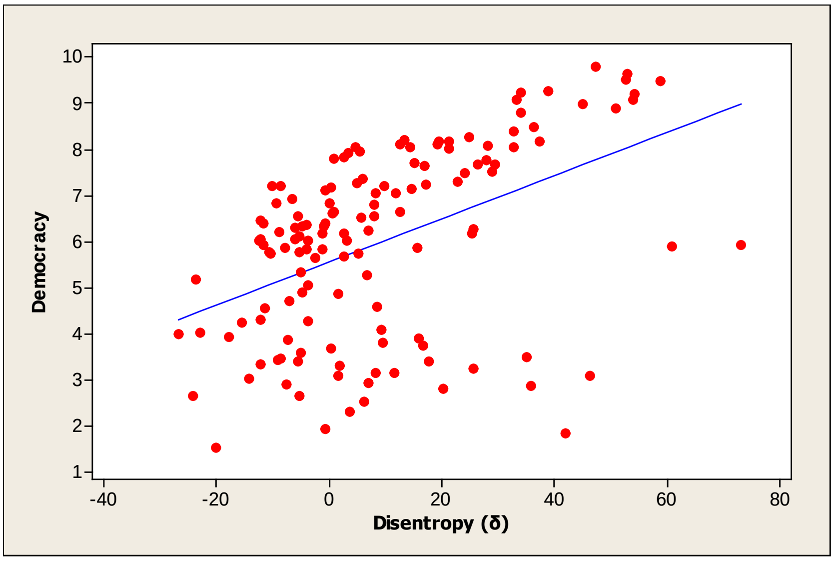
- Individuals share a homogeneous *culture* and a sense of common *identity*.
- They are provided with solid and consolidated public and private *institutional structures* supporting high level education and innovation policies.
- They have mainly *democratic systems* of governance.

From an overall perspective the scatterplot depicted in Figure 12 reveals a moderate Pearson correlation of 46.8% that evidences a relationship between *Democracy* and *Disentropy.* In spite of that, top ordered economies do not necessarily hold strong *democratic systems*. In fact, Singapore, Hong Kong and Qatar were ranked in the 80, 82 and 137 positions out of 167 countries in the Democracy index of the period 2010[13]. Hence, what matters for achieving economic order is the effectiveness of governance, which in accordance with the results obtained, in some cases seems to be independent from the government system.

Figure 12. Disentropy vs Democracy



Notes: Democracy = 5.56 + $(0.47 \cdot 10^{-1}) \cdot \delta$; Pearson correlation = 0,468; p=0.000; S=1.79; R-Sq (adjusted) = 21.3%

The above mentioned common patterns of the top 10 *ordered* economies, namely, knowledge driven, international focus, small population, uniform culture, solid institutions and democratic governance, determine a transparent and low conflict environment reverting into high *transactionality* and, in the end, greater *economic order*.

13. The Democracy Index is calculated based on the measure of five drivers of democratic systems: electoral process and pluralism, functioning of government, political participation, political culture and civil liberties (Economist Intelligence Unit, 2010).

4. Conclusion

The knowledge economy is characterized by the prominence of knowledge as input and output in economic processes. This feature makes a crucial difference between the current economic scenario and the prior industrial era where material factors and products, in particular income, constituted the foundation and lead of economic growth and social welfare. Moreover, the current frantic development of technology and the broadening of network frameworks have increased the capacity of economic agents to *transact*. In this way, the nature of economic transactions has expanded its scope embracing exchanges that contribute to the output of the economy without even having a monetary counterpart. As a consequence of the above there's a need to bring up alternative ways to appraise the new economic dynamics, and we do so by formulating a model for measuring the *Economic Order*.

Up to our days the science of economics has basically assessed the performance of an economy using models constructed on classic *price formation theories* to make measures of *material* output and its distribution across the society. We refer to the measure of *income growth* and *social welfare*. Now it is time to look into new models that produce output indicators collecting both the *material* and *immaterial* drivers of the economy, and that, to their best extent, are capable of intertwining growth and welfare theories in order to measure and understand economic order. In the end, the aim of such theoretical framework is to lay the foundations to produce economic policies pursuing the achievement of an ordered and leveled economy.

In this paper we have developed a theoretical model that considers the *transaction* as the basic unit driving the economy, instead of the *price* which was the central vehicle used by the classics. The proposed mathematical model incorporates the 4 variables denominated economic optimizers of *Governance* (G), *Conflict* (C), *Wealth* (W) and *Mutuality* (M) that inherently contain a measure of the above mentioned capacity to transact. We have called this property *Transactionality*.

The output of the model is a measure of *economic order* named *Disentropy*. The *Disentropy* index δ is the dependent (explained) variable that gives a qualitative/ordinal value of *order*. The independent (explanatory) variables G, C W and M gather the contribution to order of both the material and immaterial drivers of the economy.

Human distorting patterns like *preferences* and *utilities* of classic choice theory are kept exogenous to the model preventing that self fulfilling satisfaction desires of individuals degrade the process of optimization of the defined order output variable.

The outcome of the empirical analysis based on the proposed model discloses that, due to the fact that the *Disentropy* function δ complies with $\partial \delta / \partial t > 0$, the most ordered economies are those that have higher *Transactionality*. This characteristic is common in knowledge intensive economies with an international focus, holding advanced democratic systems and ruled by good governance characterized as being transparent, participatory and non-corrupt. Furthermore, they are distinguished by the fact that they release economic policies enabling innovation, research and entrepreneurship, and they are endowed with solid institutions providing a broad range of great

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quality public services (i.e. education, healthcare). An additional feature, although not the primary one, is that they all have a high income per capita.

The function of *Disentropy* for the analyzed sample of countries is concave. Therefore, we interpret that the increase of *order* is reduced by more than a proportional change throughout the tested cross-sectional group of 142 economies of the world in the period 2010-2011. *Wealth* shows a decreasing contribution to order as economies advance towards higher levels of order of the *Disentropy* index δ.

The road map of economists, politicians and governors of the knowledge economy ought to go through the *ordering* and *leveling* of the economy even at the expense of exponential wealth growth rates as those achieved in recent past history.

Next research challenges following the model of economic order presented in this paper will be first the incorporation of new explanatory variables permitting a more accurate and complete evaluation of the *Disentropy* index (i.e.: innovation, entrepreneurship, education, demography), second the study and measure in depth of the interaction between the different economic optimizers (*Governance*, *Conflict*, *Wealth* and *Mutuality*) and last but not least the analysis of temporary series in order to better appraise the mechanisms that drive the evolution of economic order over time.

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Annexes

Annex 1: Hessian of the Disentropy Cobb-Douglas analogous function

Given a disentropic Cobb-Douglas analogous function:

$$\delta_{CD} = F(G, W, C, M) = G^{\alpha_1} W^{\alpha_2} C^{\alpha_3} M^{\alpha_4}$$

Where:

δ_{CD} = *Disentropy* index of economic order
G = *Governance*
W = *Wealth*
C = *Conflict*
M = *Mutuality*
α_i = Fractions of order output contributed by G, W, C and M

The hessian H of function F is the determinant of the matrix hereunder:

$$H = \begin{pmatrix} \frac{\partial^2 F(G,W,C,M)}{\partial G^2} & \frac{\partial^2 F(G,W,C,M)}{\partial G \partial W} & \frac{\partial^2 F(G,W,C,M)}{\partial G \partial C} & \frac{\partial^2 F(G,W,C,M)}{\partial G \partial M} \\ \frac{\partial^2 F(G,W,C,M)}{\partial W \partial G} & \frac{\partial^2 F(G,W,C,M)}{\partial W^2} & \frac{\partial^2 F(G,W,C,M)}{\partial W \partial C} & \frac{\partial^2 F(G,W,C,M)}{\partial W \partial M} \\ \frac{\partial^2 F(G,W,C,M)}{\partial C \partial G} & \frac{\partial^2 F(G,W,C,M)}{\partial C \partial W} & \frac{\partial^2 F(G,W,C,M)}{\partial C^2} & \frac{\partial^2 F(G,W,C,M)}{\partial C \partial M} \\ \frac{\partial^2 F(G,W,C,M)}{\partial M \partial G} & \frac{\partial^2 F(G,W,C,M)}{\partial M \partial W} & \frac{\partial^2 F(G,W,C,M)}{\partial M \partial C} & \frac{\partial^2 F(G,W,C,M)}{\partial M^2} \end{pmatrix}$$

The elements of the matrix are the expressions:

$$\frac{\partial F(G,W,C,M)}{\partial G} = \alpha_1 G^{\alpha_1 - 1} W^{\alpha_2} C^{\alpha_3} M^{\alpha_4}$$
$$\frac{\partial F(G,W,C,M)}{\partial W} = \alpha_2 G^{\alpha_1} W^{\alpha_2 - 1} C^{\alpha_3} M^{\alpha_4}$$
$$\frac{\partial F(G,W,C,M)}{\partial C} = \alpha_3 G^{\alpha_1} W^{\alpha_2} C^{\alpha_3 - 1} M^{\alpha_4}$$

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$$\frac{\partial F(G,W,C,M)}{\partial M} = \alpha_4 G^{\alpha_1} W^{\alpha_2} C^{\alpha_3} M^{\alpha_4 - 1}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial G^2} = \alpha_1(\alpha_1 - 1) G^{\alpha_1 - 2} W^{\alpha_2} C^{\alpha_3} M^{\alpha_4}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial W^2} = \alpha_2(\alpha_2 - 1) G^{\alpha_1} W^{\alpha_2 - 2} C^{\alpha_3} M^{\alpha_4}$$

$$\frac{\partial^2 F(G,W,C,M)}{\partial C^2} = \alpha_3(\alpha_3 - 1) G^{\alpha_1} W^{\alpha_2} C^{\alpha_3 - 2} M^{\alpha_4}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial M^2} = \alpha_4(\alpha_4 - 1) G^{\alpha_1} W^{\alpha_2} C^{\alpha_3} M^{\alpha_4 - 2}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial G \partial W} = \frac{\partial^2 F(G,W,C,M)}{\partial W \partial G} = \alpha_1 \alpha_2 G^{\alpha_1 - 1} W^{\alpha_2 - 1} C^{\alpha_3} M^{\alpha_4}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial G \partial C} = \frac{\partial^2 F(G,W,C,M)}{\partial C \partial G} = \alpha_1 \alpha_3 G^{\alpha_1 - 1} W^{\alpha_2} C^{\alpha_3 - 1} M^{\alpha_4}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial G \partial M} = \frac{\partial^2 F(G,W,C,M)}{\partial M \partial G} = \alpha_1 \alpha_4 G^{\alpha_1 - 1} W^{\alpha_2} C^{\alpha_3} M^{\alpha_4 - 1}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial W \partial C} = \frac{\partial^2 F(G,W,C,M)}{\partial C \partial W} = \alpha_2 \alpha_3 G^{\alpha_1} W^{\alpha_2 - 1} C^{\alpha_3 - 1} M^{\alpha_4}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial W \partial M} = \frac{\partial^2 F(G,W,C,M)}{\partial M \partial W} = \alpha_2 \alpha_4 G^{\alpha_1} W^{\alpha_2 - 1} C^{\alpha_3} M^{\alpha_4 - 1}$$
$$\frac{\partial^2 F(G,W,C,M)}{\partial C \partial M} = \frac{\partial^2 F(G,W,C,M)}{\partial M \partial C} = \alpha_3 \alpha_4 G^{\alpha_1} W^{\alpha_2} C^{\alpha_3 - 1} M^{\alpha_4 - 1}$$

Let F be the function of *Disentropy* δ_{CD} and G, W, C, M ∈ S.

Let G, W. C M be the independent variables of the function of *Disentropy* with continuous partial derivatives of first and second order on the convex open set S.

We denote the Hessian of F at the point x ∈ S by H(x).

Then

1. F is *concave* if and only if H(x) is negative semidefinite for all x ∈ S
2. F is *strictly concave* if H(x) is negative definite for all x ∈ S
3. F is *convex* if and only if H(x) is positive semidefinite for all x ∈ S
4. F is *strictly convex* if H(x) is positive definite for all x ∈ S

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Annex 2: Synthetic indices of Governance, Wealth, Conflict and Mutuality of 142 countries. 2010-2011

Country	Wealth	Governance	Conflict	Mutuality
Finland	10.1	10.4	4.0	5.1
Switzerland	14.2	9.7	3.9	5.0
Singapore	10.9	11.2	3.9	5.3
Luxembourg	14.3	9.1	3.9	5.1
Sweden	16.0	10.1	3.9	5.0
Hong Kong SAR	26.2	9.7	3.8	5.6
Denmark	13.2	9.6	4.0	4.9
United Kingdom	10.6	8.4	3.4	4.9
Canada	8.1	9.0	3.4	4.3
Ireland	7.4	8.3	3.7	4.8
France	8.7	7.7	3.4	4.5
Austria	7.9	8.4	3.7	5.1
Norway	13.8	9.0	3.8	4.8
Taiwan, China	4.5	8.4	3.6	4.7
New Zealand	5.4	9.6	3.7	4.7
Netherlands	13.3	9.2	3.4	4.8
Barbados	3.7	9.0	3.4	4.7
Germany	8.7	8.2	3.6	4.7
Bahrain	3.0	9.5	3.6	4.8
Japan	6.2	8.2	3.5	4.6
Puerto Rico	5.9	6.5	2.6	4.2
Saudi Arabia	2.2	9.5	4.1	5.5
Australia	7.5	8.5	3.8	4.6
Oman	1.6	9.3	4.0	4.9
Cyprus	4.1	8.1	3.5	4.2
Namibia	0.4	7.6	2.8	3.8
Belgium	9.8	7.7	3.7	4.8
Malaysia	1.6	8.8	3.2	4.7
Estonia	4.2	8.5	3.7	4.7
South Africa	0.7	7.0	1.9	4.4
Israel	4.7	7.6	3.3	5.0
Malta	4.7	7.5	3.9	4.6
Mauritius	1.3	7.6	3.3	4.1
Jordan	0.7	7.5	3.6	4.4
Iceland	18.4	8.7	4.1	4.7
Botswana	0.6	8.4	3.2	4.0
Rwanda	0.0	9.8	3.8	3.4

Source: Own elaboration based on data extracted from World Economic Forum (2011), International Telecommunication Union (2011) and International Monetary Fund (2011).

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Country	Wealth	Governance	Conflict	Mutuality
Gambia, The	0.0	8.8	3.3	3.7
United States	7.2	7.7	2.9	4.5
Uruguay	2.5	7.7	3.4	4.5
China	1.3	7.9	3.2	3.6
Chile	2.3	9.0	3.2	4.6
Kuwait	2.8	6.7	3.7	4.5
Spain	6.1	7.0	3.4	4.5
Tunisia	1.0	8.3	3.4	4.3
United Arab Emirates	6.3	9.3	4.1	5.1
Qatar	6.8	10.0	3.8	5.1
Portugal	6.7	6.3	3.7	5.0
Panama	1.7	7.2	2.5	5.5
Montenegro	1.8	8.3	3.6	4.8
Syria	0.2	6.0	4.2	3.3
Brunei Darussalam	3.2	8.1	3.9	4.1
Korea, Rep	5.5	6.3	3.1	4.5
Poland	3.2	6.6	3.5	4.1
Sri Lanka	0.3	7.5	3.4	4.0
Greece	4.5	5.6	3.1	4.0
Lebanon	1.2	5.6	3.1	3.5
Ethiopia	0.0	7.0	3.5	2.5
Brazil	1.7	6.2	2.2	4.3
Slovenia	6.3	6.4	3.8	4.0
Iran, Islamic Rep	0.4	6.6	2.8	3.5
Morocco	0.5	7.1	3.2	4.1
Swaziland	0.2	6.0	2.9	2.9
Lithuania	4.1	6.7	3.4	4.8
Benin	0.1	7.0	2.5	3.5
Hungary	3.1	6.3	3.2	4.5
Jamaica	1.0	6.1	1.4	4.3
Costa Rica	1.4	7.3	2.4	4.0
India	0.2	6.8	3.0	3.9
Burkina Faso	0.1	6.4	3.0	2.8
Italy	6.0	5.6	2.6	4.1
Turkey	2.0	6.6	2.9	4.0
Zambia	0.1	7.1	3.1	3.3
Latvia	3.6	6.4	3.3	3.9
Egypt	0.5	6.5	3.0	3.7
Uganda	0.0	6.8	2.5	3.3
Senegal	0.1	6.4	3.7	4.0
Czech Republic	4.8	6.0	3.4	4.7
Slovak Republic	3.1	5.9	3.1	4.4
Mexico	1.8	6.2	1.7	3.9
Malawi	0.0	7.0	3.0	2.9

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Country	Wealth	Governance	Conflict	Mutuality
Ghana	0.1	7.2	2.9	3.5
Trinidad and Tobago	2.5	6.4	1.9	4.5
Indonesia	0.3	7.3	2.7	4.0
Romania	2.8	5.7	3.1	3.8
Croatia	3.9	5.9	3.2	4.4
Colombia	1.2	6.5	1.7	3.9
Dominican Republic	0.8	5.4	2.3	4.0
Peru	0.8	6.5	2.3	4.1
Azerbaijan	1.2	6.9	3.3	3.9
Belize	0.7	5.4	2.0	3.1
Cape Verde	0.5	7.4	2.7	3.8
Tajikistan	0.1	7.3	3.2	3.5
Cambodia	0.1	7.1	2.7	3.6
Armenia	0.6	6.9	3.5	4.0
El Salvador	0.5	6.0	1.2	4.2
Honduras	0.3	6.4	1.7	4.3
Vietnam	0.6	6.7	2.9	4.5
Bangladesh	0.0	6.0	2.7	3.2
Guyana	0.4	6.4	2.3	3.5
Macedonia, FYR	1.9	6.4	3.0	3.7
Kenya	0.1	6.2	2.3	3.7
Suriname	0.8	5.9	3.0	4.2
Cameroon	0.1	6.2	2.9	3.0
Philippines	0.4	5.7	2.5	4.0
Guatemala	0.4	5.8	1.1	4.5
Kazakhstan	1.3	6.5	2.8	3.9
Thailand	0.8	7.1	3.0	4.1
Mauritania	0.1	5.8	3.0	3.1
Tanzania	0.0	6.9	2.8	3.0
Mozambique	0.0	6.7	2.5	3.2
Mali	0.1	6.4	3.0	3.1
Lesotho	0.1	5.8	2.6	2.8
Pakistan	0.1	6.0	2.1	3.3
Albania	0.8	7.6	3.3	4.5
Yemen	0.1	4.0	2.7	2.6
Moldova	1.5	6.0	3.2	3.5
Mongolia	0.7	5.6	3.1	3.7
Bulgaria	4.3	5.8	2.5	4.0
Georgia	0.9	7.5	3.3	3.4
Nicaragua	0.2	5.7	2.6	3.2
Nigeria	0.1	6.2	2.2	3.4
Ecuador	0.5	5.7	2.2	3.6
Nepal	0.1	5.9	2.1	2.8
Côte d'Ivoire	0.1	5.4	1.9	3.7

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Country	Wealth	Governance	Conflict	Mutuality
Serbia	2.1	7.2	2.8	5.2
Algeria	0.6	7.4	2.3	4.7
Paraguay	0.3	6.7	2.3	4.8
Bosnia Herzegovina	1.7	8.2	2.2	4.8
Russian Federation	2.4	7.7	3.0	5.4
Madagascar	0.0	6.5	1.6	4.0
Timor-Leste	0.0	7.3	1.9	4.1
Argentina	2.0	7.2	2.8	5.5
Angola	0.3	6.3	1.8	4.2
Burundi	0.0	6.4	1.3	3.3
Bolivia	0.3	7.2	2.1	4.3
Ukraine	1.1	6.9	2.5	5.2
Chad	0.1	6.5	1.5	3.6
Kyrgyz Republic	0.1	6.2	2.0	4.1
Zimbabwe	0.1	7.5	2.0	4.4
Haiti	0.0	5.6	1.4	3.7
Venezuela	1.3	5.6	1.9	4.4

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Annex 3: Disentropy indices of 142 countries of the world economy in the period 2010-2011

	Disentropy (δ) measure of economic order					
	Logit Model		OLS Model		Cobb-Douglas Model	
Country	δ_{na}	**Rank a**	δ_{nb}	**Rank b**	δ_{CD}	**Rank CD**
Hong Kong SAR	158.58	1	2.050	2	7.022	2
Singapore	146.32	2	2.060	1	7.099	1
Sweden	144.25	3	2.017	3	6.942	3
Finland	139.71	4	2.011	4	6.894	4
Switzerland	139.40	5	1.987	5	6.821	5
Iceland	138.37	6	1.943	9	6.644	10
Denmark	138.03	7	1.981	6	6.786	6
Luxembourg	136.23	8	1.957	8	6.686	8
Norway	132.77	9	1.934	10	6.630	11
Qatar	131.72	10	1.957	7	6.698	7
Netherlands	130.40	11	1.924	12	6.648	9
United Arab Emirates	128.94	12	1.927	11	6.540	12
Saudi Arabia	127.36	13	1.887	14	6.352	18
New Zealand	124.35	14	1.901	13	6.529	13
United Kingdom	122.85	15	1.865	15	6.398	15
Austria	121.88	16	1.864	16	6.355	17
Oman	121.28	17	1.830	22	6.204	24
Bahrain	120.44	18	1.856	17	6.356	16
Australia	119.62	19	1.850	19	6.335	19
Ireland	119.55	20	1.847	20	6.309	20
Canada	118.85	21	1.853	18	6.430	14
Germany	118.18	22	1.832	21	6.283	22
Belgium	118.16	23	1.818	24	6.210	23
Barbados	116.63	24	1.829	23	6.285	21
Estonia	115.00	25	1.810	25	6.194	27
Taiwan, China	114.52	26	1.808	26	6.198	26
Japan	113.77	27	1.803	27	6.204	25

Notes: Next are the regression equations used to calculate the Disentropy values of the Logit, OLS and CD models:
Logit Model: δ_{na} = 5,08095 • G – 0,830058 • W – 5,27025 • C + 6,64935 • M
OLS Model: δ_{nb} = 44,2574 • ln G – 1,15284 • ln W – 15,0209 • ln C + 44,3017 • ln M
CD Model: $\delta_{CD} = G^{0.5543} \cdot W^{0.06356} \cdot C^{0.17451} \cdot M^{0.20026}$

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	Logit Model		OLS Model		Cobb-Douglas Model	
Country	δ_{na}	**Rank a**	δ_{nb}	**Rank b**	δ_{CD}	**Rank CD**
France	113.33	28	1.788	28	6.160	28
Chile	111.96	29	1.777	29	6.138	29
Montenegro	111.08	30	1.746	35	5.964	36
Rwanda	111.08	31	1.547	62	5.460	62
Malaysia	110.77	32	1.750	34	6.034	32
Malta	110.43	33	1.755	30	5.986	35
Israel	109.63	34	1.755	31	6.017	34
Brunei Darussalam	109.27	35	1.752	33	6.026	33
Cyprus	108.30	36	1.753	32	6.057	30
United States	106.78	37	1.739	36	6.055	31
Portugal	106.71	38	1.690	39	5.760	40
Tunisia	105.64	39	1.676	40	5.796	39
Spain	104.91	40	1.706	37	5.879	37
Uruguay	104.74	41	1.701	38	5.863	38
Gambia, The	103.31	42	1.482	77	5.277	80
Lithuania	102.62	43	1.673	41	5.750	41
Botswana	102.54	44	1.629	46	5.696	44
Jordan	102.29	45	1.618	50	5.593	52
Kuwait	101.52	46	1.653	42	5.679	46
Albania	101.04	47	1.615	51	5.604	51
Slovenia	100.51	48	1.649	43	5.710	42
Panama	100.05	49	1.626	47	5.665	49
Mauritius	99.92	50	1.634	44	5.693	45
Czech Republic	98.92	51	1.621	49	5.591	53
Sri Lanka	98.13	52	1.533	65	5.390	72
Korea, Rep	98.04	53	1.630	45	5.666	48
Poland	97.33	54	1.624	48	5.645	50
China	96.94	55	1.615	52	5.700	43
Hungary	95.40	56	1.598	54	5.565	55
Morocco	95.00	57	1.530	66	5.394	71
Armenia	94.76	58	1.533	64	5.386	73
Georgia	94.12	59	1.568	57	5.560	56

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	Disentropy (δ) measure of economic order					
	Logit Model		OLS Model		Cobb-Douglas Model	
Country	δ_{na}	**Rank a**	δ_{nb}	**Rank b**	δ_{CD}	**Rank CD**
Puerto Rico	93.94	60	1.605	53	5.679	47
Latvia	93.84	61	1.593	55	5.584	54
Azerbaijan	93.68	62	1.559	58	5.482	60
Thailand	93.42	63	1.548	61	5.470	61
Croatia	93.37	64	1.571	56	5.487	59
Namibia	92.59	65	1.515	70	5.416	67
Vietnam	92.56	66	1.506	72	5.326	77
Senegal	92.10	67	1.406	93	5.040	98
Tajikistan	91.64	68	1.378	98	5.030	101
Slovak Republic	91.47	69	1.550	60	5.439	64
Indonesia	91.19	70	1.475	79	5.299	79
Cape Verde	91.00	71	1.510	71	5.408	68
Turkey	90.76	72	1.557	59	5.508	58
India	90.30	73	1.430	87	5.146	91
Costa Rica	90.07	74	1.547	63	5.551	57
Syria	89.09	75	1.389	95	5.015	104
Greece	88.92	76	1.525	67	5.394	70
Ghana	88.66	77	1.393	94	5.093	95
Italy	88.20	78	1.523	69	5.430	66
Zambia	88.13	79	1.371	99	5.039	99
Macedonia, FYR	88.10	80	1.525	68	5.431	65
Kazakhstan	87.46	81	1.503	74	5.373	74
Egypt	87.12	82	1.443	84	5.196	86
Cambodia	87.06	83	1.369	101	5.042	97
Suriname	86.41	84	1.449	83	5.183	88
South Africa	86.22	85	1.456	81	5.314	78
Romania	86.21	86	1.498	76	5.334	75
Ethiopia	85.85	87	1.244	126	4.769	126
Trinidad and Tobago	85.80	88	1.502	75	5.443	63
Bulgaria	85.49	89	1.504	73	5.400	69
Iran, Islamic Rep	84.82	90	1.422	89	5.175	90
Brazil	84.80	91	1.478	78	5.332	76

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	Disentropy (δ) measure of economic order					
	Logit Model		OLS Model		Cobb-Douglas Model	
Country	δ_{na}	Rank a	δ_{nb}	Rank b	δ_{CD}	Rank CD
Peru	84.74	92	1.451	82	5.267	83
Moldova	84.66	93	1.467	80	5.267	82
Malawi	84.42	94	1.241	128	4.758	129
Benin	84.29	95	1.326	108	4.957	109
Tanzania	83.07	96	1.269	112	4.830	115
Mali	81.86	97	1.257	118	4.778	123
Russian Federation	81.71	98	1.438	85	5.195	87
Uganda	81.68	99	1.265	114	4.821	117
Mongolia	81.59	100	1.382	96	5.036	100
Lebanon	81.44	101	1.414	92	5.130	92
Serbia	80.83	102	1.428	88	5.176	89
Mozambique	80.68	103	1.250	122	4.798	120
Burkina Faso	80.57	104	1.242	127	4.762	128
Bosnia and Herzegovina	80.46	105	1.432	86	5.215	85
Honduras	80.29	106	1.331	107	5.016	103
Philippines	80.19	107	1.354	103	4.993	105
Zimbabwe	80.17	108	1.245	125	4.742	130
Cameroon	79.93	109	1.260	117	4.796	121
Colombia	79.87	110	1.417	91	5.266	84
Ukraine	79.55	111	1.381	97	5.043	96
Guyana	79.46	112	1.370	100	5.097	94
Mexico	78.86	113	1.418	90	5.274	81
Kenya	78.46	114	1.246	124	4.776	124
Mauritania	78.26	115	1.251	121	4.766	127
Swaziland	77.94	116	1.300	110	4.904	111
Bangladesh	77.67	117	1.204	131	4.670	131
Nigeria	76.88	118	1.253	120	4.811	118
Jamaica	76.79	119	1.353	104	5.122	93
Dominican Republic	76.75	120	1.338	105	4.976	107
Algeria	76.32	121	1.334	106	4.979	106
Argentina	76.21	122	1.358	102	5.024	102
Timor-Leste	75.33	123	1.167	133	4.615	136

	Disentropy (δ) measure of economic order					
	Logit Model		OLS Model		Cobb-Douglas Model	
Country	δ_{na}	**Rank a**	δ_{nb}	**Rank b**	δ_{CD}	**Rank CD**
Nicaragua	75.00	124	1.256	119	4.799	119
Ecuador	74.75	125	1.306	109	4.933	110
Pakistan	74.22	126	1.228	130	4.775	125
Bolivia	73.83	127	1.267	113	4.851	114
Paraguay	73.73	128	1.262	115	4.823	116
El Salvador	73.44	129	1.271	111	4.959	108
Guatemala	73.38	130	1.236	129	4.870	112
Kyrgyz Republic	73.38	131	1.178	132	4.616	135
Angola	73.29	132	1.250	123	4.780	122
Lesotho	73.08	133	1.164	134	4.620	134
Côte d'Ivoire	71.32	134	1.147	137	4.584	137
Nepal	70.11	135	1.158	135	4.643	133
Belize	69.30	136	1.261	116	4.869	113
Madagascar	67.77	137	1.054	138	4.405	139
Chad	65.44	138	1.052	139	4.418	138
Burundi	62.72	139	0.925	142	4.194	142
Venezuela	61.87	140	1.150	136	4.661	132
Yemen	61.25	141	0.995	140	4.277	140
Haiti	58.69	142	0.944	141	4.238	141

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Resumen

El advenimiento de la economía del conocimiento ha transformado el comportamiento de los agentes económicos y la naturaleza de las transacciones. En particular, el incremento de transacciones basadas en el conocimiento no asociadas a flujos monetarios está debilitando el significado de medidas tradicionales de la dinámica económica como el Producto Interior Bruto (PIB) o el Ingreso Nacional (IN). El objetivo de este documento de trabajo es mejorar la medida de la nueva dinámica económica introduciendo un modelo que mide y explica el Orden Económico en la economía del conocimiento en función de las dimensiones de Gobernanza, Riqueza, Conflicto y Mutualidad. La Renta, componente de la dimensión de Riqueza, es una variable independiente del modelo. Su maximización no es un objetivo en el marco económico analizado. Consecuentemente, el crecimiento de la renta y de la producción no son objetivos principales, si no que tienen una contribución complementaria en el Orden. Por otra parte, el Bienestar no se construye exclusivamente como una distribución óptima de la renta fundamentada en las utilidades y preferencias individuales, si no que se basa en el orden económico. La Transacción es el vehículo que constituye la unidad mínima que facilita o impide los intercambios dentro de cada uno de las dimensiones económicas y entre ellas mismas. Se realiza un análisis empírico sobre una muestra de corte transversal de datos cuantitativos y cualitativos de 142 países de la economía mundial en el período 2010-2011. Se formula una regresión Logit donde la variable dependiente que explica el orden es un índice denominado Disentropía. Una menor desigualdad de la renta (Gini) no significa un mayor Orden. A medida que una economía alcanza un mayor Orden la Riqueza se convierte en una dimensión menos relevante. El Desarrollo Humano (IDH) está correlacionado positivamente con el Orden económico. La función lineal de Disentropía se normaliza para obtener una función análoga a una Cobb-Douglas. Esta función es doblemente diferenciable y el determinante de su matriz hessiana es menor que cero evidenciando un comportamiento cóncavo de la variable Disentropía. Por lo tanto el Orden presenta rendimientos decrecientes a escala en la muestra de países considerada. Se presenta una clasificación de las economías más ordenadas del mundo que probablemente tienen en común las características siguientes: intensivas en conocimiento, apertura internacional, población reducida, cultura homogénea, identidad propia, instituciones sólidas y principalmente democracias.

Palabras clave

Economía del conocimiento, Orden económico, Disentropía, Transaccionalidad, Regresión Logit.

Resumen

L'adveniment de l'economia del coneixement ha transformat el comportament dels agents econòmics i la naturalesa de les transaccions. En particular, l'increment de transaccions basades en el coneixement no associades a fluxos monetaris està debilitant el significat de mesures tradicionals de la dinàmica econòmica com el Producte Interior Brut (PIB) o l' Ingrés Nacional (IN). L'objectiu d'aquest document de treball és millorar la mesura de la nova dinàmica econòmica introduint un model que mesura i explica l'Ordre Econòmic a l'economia del coneixement en funció de les dimensions de Governança, Riquesa, Conflicte i Mutualitat. La Renda, component de la dimensió de Riquesa, és una variable independent del model. La seva maximització no és un objectiu en el marc econòmic analitzat. Conseqüentment, el creixement de la renda i de la producció no són objectius principals, si no que tenen una contribució complementària en l'Ordre. D'altre banda el Benestar no es construeix exclusivament com a una distribució òptima de la renda fonamentada en les utilitats i preferències individuals, si no que es basa en l'ordre econòmic. La Transacció és el vehicle que constitueix la unitat mínima que facilita o impedeix els intercanvis dins de cadascuna de les dimensions econòmiques i entre elles mateixes. Es realitza una anàlisi empírica sobre una mostra de tall transversal de dades quantitatives i qualitatives de 142 països de l'economia mundial en el període 2010-2011. Es formula una regressió Logit a on la variable depenent que explica l'ordre és un índex denominat Disentropia. Una menor desigualtat de la renda (Gini) no significa un major Ordre. A mesura que una economia ateny un major Ordre la Riquesa esdevé una dimensió menys rellevant. El Desenvolupament Humà (IDH) està positivament correlacionat amb l'Ordre econòmic. La funció linear de Disentropia es normalitza per obtenir una funció anàloga a una Cobb-Douglas. Aquesta funció és doblement diferenciable i el determinant de la seva matriu hessiana és menor que zero evidenciant un comportament còncau de la variable. Es presenta un rànquing de les economies més ordenades del món que probablement tenen en comú les següents característiques: intensives en coneixement, obertura internacional, població reduïda, cultura homogènia, identitat pròpia, institucions sòlides i principalment democràcies.

Paraules clau:

Economia del coneixement, Ordre econòmic, Disentropia, Transaccionalitat, Regressió Logit.

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