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Market Stability in Light of Behavioral and Evolutionary Economics

The first attempt to account for and explain economic phenomena was Adam Smith's analysis presented in his famous *An Inquiry into the Nature and Causes of the Wealth of Nations* (Smith 1776). In the history of economic thought, this treatise marks the first milestone in the development of modern economics. Smith propagated the ideas of the free market, and it was not until the onset of the Great Depression in 1930 that economists' attention was drawn to the role of the state as a moderator of demand. John Maynard Keynes, the author of *The General Theory of Employment, Interest and Money*, considered demand the cornerstone of economics (Keynes 1936). He believed demand is the prime mover of the economy and the role of the state is to provide an adequate level of state investment ensuring full employment so that consumers have cash resources enabling them to make purchases and generate demand. State-induced demand will stimulate supply and in consequence cause the economy to flourish. Keynesianism was the dominating school of economic thought for the next several decades, until in the late 1960s it lost that position to the Chicago School, whose main representative was Milton Friedman (Nobel prize winner 1976).

Friedman propagated the ideas of the free market and free competition. He believed that the market is effective, always tending to equilibrium, so any state intervention in the economy is harmful as it causes monetary ineffectiveness. The role of the state in the economy should be limited to controlling inflation and money supply, in proportion to economic growth. Friedman allowed for state intervention in exceptional circumstances, but the general position of his neoliberalism was that the state should not interfere with the economy.

Keynesian state interventionism was opposed, and Friedman's free-market economy favored, by Friedrich August von Hayek (Nobel Prize winner 1974) of the Austrian School of Economics. Hayek was one of the first economists to observe that the principles governing the market and the economy evolve and note an analogy between the rules of changes in the market and the Darwin–Wallace

rules of evolution. One of the cornerstones of the Darwin–Wallace theory[1] is the principle of natural selection, a mechanism of population change allowing populations to adjust and pass their genes in the best possible way. Hayek claimed that the set of principles and rules governing the market is subject to the laws of evolution and the principle of natural selection in such a way as to make the market ever more effective.

The turn of the twentieth century saw the emergence of a new trend: behavioral economics. It is concerned with investigating the reasons for making decisions, analyzing variations between the expected and actual outcomes of a decision, and explaining the causes of such differences. The theory of behavioral analysis obtained a breakthrough boost from research by Daniel Goleman, a professor at Harvard, who introduced the concept of emotional intelligence in 1991 (Goleman 2005). Based on his investigations into investment decisions made by business practitioners, the executive staff of big companies, Goleman demonstrated that only twenty percent of the decisions made could be accounted for by rational reasons. The remaining eighty percent were based on non-rational, unquantifiable reasons. Emotional intelligence (EQ), which humans have acquired in the process of evolution, complements so-called logical-mathematical intelligence (IQ) and is a set of competencies directly related to behavioral abilities based on emotions. According to Goleman "[t]hese two different kinds of intelligence – intellectual and emotional – express the activity of different parts of the brain. The intellect is based solely on the workings of the neocortex, the more recently evolved layers at the top of the brain. The emotional centers are lower in the brain, in the more ancient subcortex; emotional intelligence involves these emotional centers at work, in concert with the intellectual centers."(Goleman 1999). Goleman's contribution to research on the behavioral aspect of human personality was followed up on by two economists whose work constitutes the foundation of behavioral economics: Daniel Kahneman and Amos Tversky.

Daniel Kahneman (Nobel Prize winner 2002), a psychology professor at Princeton University and one of the main proponents of behavioral economics, has focused on investigations into human decision making under uncertainty. Kahneman believes that most decisions made by people are irrational because that is implied by the structure of the human brain (Kahneman, Tversky 2000). Kahneman's research results yield the following paradigms: individuals have a tendency to behave like the group they belong to (social identity); they evaluate the likelihood of an event based on how difficult it is to understand it; the way a problem is presented affects the choice of method used to solve it; absent his/her own opinion, an individual will make the decision made by the group he/she belongs to (social learning); people value altruism and think heuristically. The human brain processes that Kahneman describes lead to choices made when faced with

[1] Charles Darwin and Alfred Russel Wallace concurrently and independently developed a theory of evolution now called the Darwin–Wallace evolution theory.

investment decisions, whereas the irrationality of human thinking that result from those processes generates irrational financial-investment decisions. Kahneman's research in conjunction with advances in neurobiology has shown that the human brain has two pathways (Kahneman 2011) for the acquisition of stimuli from the environment, resulting in information being brought to the amygdala, the part of the brain responsible for detecting threats from the outside world and organizing adequate responses. The two pathways are associated with two systems: One is fast thinking, the most primitive, intuitive, and emotional thinking, outside the conscious mind; it is thanks to this pathway that a threat is detected immediately and the individual takes adequate action. The other is what Kahneman's terms slow thinking: the pathway through the neocortex, developed much later in the process of brain evolution; it is longer and involves logical analysis. The mind of a human being under stress, confronted with a serious problem, pressed for time, spontaneously switches to the fast-thinking pathway and makes decisions driven by emotions, without engaging in rational analysis (for lack of time or sufficient competency). Results of analyses show that in most cases people are characterized by a certain kind of laziness that consists of succumbing to emotions and relying on intuitive decisions based on fast, emotional thinking. Research results reveal that in close to eighty percent of decision-making situations, including business-related and economic ones, people rely on this kind of thinking. In effect, a substantial portion of people's decisions are irrational and erroneous.

One example of irrational thinking is reasoning by false mathematical induction. In mathematical induction two conditions must be satisfied to prove the truth of a statement: the cause-effect continuity between sequential events must be proved, and the initial event must be known to have taken place; if that is the case, the entire sequence is certain to be true. If one throws the dice and gets a six several times in a row, one automatically becomes convinced that the probability of a six in the next roll is not one-sixth but much higher. Such reasoning is connected with a simplified method of reasoning known in psychology as the anchoring effect (the anchoring heuristic), which consists of relying on previously received information when evaluating subsequent events, often without analyzing the connection between the two. The anchoring heuristic is visible in price negotiations, for instance when purchasing real estate, where price information obtained at the beginning gets anchored so strongly that it becomes a benchmark for the evaluation of the price of the real estate even if it is completely at odds with the market price or any rational pricing. Further negotiations aimed at lowering the price relate to the price heard at the beginning and anchored in the negotiators' minds, which means that the purchaser can be happy to buy the real estate having negotiated a 20% price decrease, even if the actual market price is 50% lower than the anchor price from which the negotiations began. Anchoring also explains decision-making phenomena taking place in capital markets: anchoring to stock price or herd-behavior information, when everybody enters into stock

market transactions, resulting in the investment of one's capital, regardless of the most important factors: the fundamental price of the stock and rational analysis of potential gains.

Another example of irrational thinking that Kahneman investigated is the process of averaging. It consists of a subjective evaluation of several elements through the averaging of their significance. This heuristic process used by the human mind is exploited in marketing: when a mediocre product is offered together with a valuable give-away that does not affect the low evaluation of the main product, the two become valuable as a result of averaging. Conversely, when, for instance, a luxury car is offered with a gift of used tires, the potential customer will feel the value of the main product to be lower and be less satisfied. Such processes occur on the edges of consciousness and are anchored deeply in emotional thinking, but they underlie the final conscious decision.

The conclusions flowing from behavioral-economics research indicate that decisions made by people in large part result from processes of irrational, deeply emotionally-anchored thinking. The consequences of such decision making can even be disastrous for individuals or populations, as demonstrated by research experiments conducted after World War Two. Extensive investigations were carried out in search of an answer to the question how it was possible for ordinary people to become involved in mass exterminations. What processes in the human mind caused ordinary citizens of Nazi Germany to take part in systematic genocide? The most famous study of this kind was the prison experiment[2] carried out by the psychologist Philip Zimbardo of Stanford University (Zimbardo 2007). Planned to last two weeks, the experiment was interrupted on day six and its results were kept secret for many years. In the experiment, students were randomly assigned the roles of prisoners and prison guards. The experiment was carried out in the basement of a Stanford University building temporarily pretending to be a prison. The whole process of arrest and imprisonment was conducted with the help of the local police and in accordance with all the rules of interrogation and detention. Both groups settled into their roles surprisingly quickly and with great commitment. Two days into the experiment, both groups believed they were in a genuine prison. The experiment was interrupted because of unbelievable aggressiveness on the part of the guards and incredible acceptance of the fictitious imprisonment on the part of the prisoners. The experiment warranted the claim that normal people can, under special circumstances, assume, previously unknown to them, roles of tormentors or victims.

One of the most shocking experiments in the history of social psychology was carried out by Stanley Milgram, professor of psychology at Yale, to study obedience to authority. It was also an attempt at answering the question about the causes of the blind obedience of the Nazis during World War Two, espe-

[2] *Stanford Prison Experiment,* retrieved from http://www.prisonexp.org/.

cially fulfilling genocide orders at death camps. The experiment involved the administration of electrical shocks as punishment for giving a wrong answer by subjects assigned the roles of teachers. The roles of teachers were assigned to randomly chosen ordinary people. The role of the learner was given to an actor, who convincingly faked receiving electrical shocks, including by going silent, which could suggest death by electrocution. Each teacher was accompanied by a professor sitting behind them, who confirmed that the experiment had to go on for the good of science. Unknown to the teachers, there were actually no electrical shocks in the experiment, but the teachers did hear the learners' pleas for an end to the experiment and screams following wrong answers and the shocks the teachers administered at increasingly higher voltages, up to 450 V. The experiment and its results, described by the author in his book *Obedience to Authority: An Experimental View* (Milgram 1975), were shocking. It turned out that 70% of the more than a thousand subjects of various ethnicities were capable of administering shocks at over 400 V to learners as punishment for a wrong answer. The experiment demonstrated that people are inclined to obey authorities and can make decisions suggested by those thought to be figures of authority and enjoying their trust.

Another example of irrational decisions being made solely in consequence of the way the problem is presented, i.e. illustration of how context distorts reasoning, is the so-called Asian disease problem.[3] The problem involves a dilemma in which one of two decisions has to be chosen. In reality the expected value of either decision is exactly the same, but the way the dilemma is framed affects the choice made.

Andrew Wen-Chuan Lo, professor of finance at MIT, is an economist currently involved in behavioral economics research. He argues that most irrational behaviors in financial markets: loss aversion, overconfidence, overreaction, mental

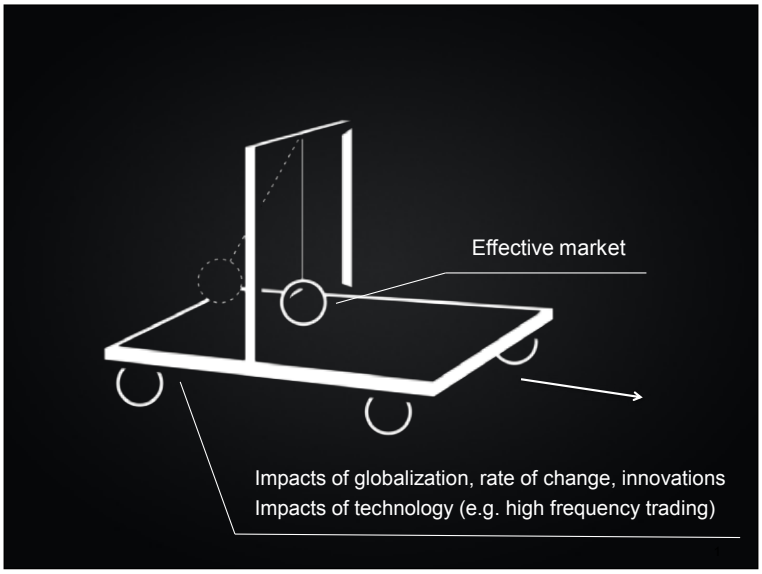
[3] "Imagine that the United States is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows: If Program A is adopted, 200 people will be saved, If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved. Which of the two programs would you favor? In this version of the problem, a substantial majority of respondents favor program A, indicating risk aversion. Other respondents, selected at random, receive a question in which the same cover story is followed by a different description of the options: If Program A' is adopted, 400 people will die. If Program B' is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die. A clear majority of respondents now favor program B', the risk-seeking option. Although there is no substantive difference between the versions, they evidently evoke different associations and evaluations." (Daniel Kahneman, "Maps of bounded rationality: a perspective on intuitive judgment and choice," in T. Frangsmyr (Ed.), *Les Prix Nobel 2002* (Stockholm, Sweden: Almquist & Wiksell International, 2003), p. 456, retrieved from http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2002/kahnemann-lecture.pdf). The experiment was originally reported on in Amos Tversky and Daniel Kahneman, "The framing of decisions and the psychology of choice," *Science* 211, no. 4481 (1981): 453–458.

accounting, and other behavioral biases result from people's evolutionary adaptation to a changing environment via simple heuristics.[4]

Figure 1 is a symbolic representation of the laws governing the economic market that have been the subject of economic investigations discussed in this article. The economic market is graphically represented by a pendulum mounted on a platform. The platform symbolizes the dynamics and changeability of the economic market, whereas the pendulum represents the tendencies existing in the market. According to Friedman's theory, the pendulum will always tend to assume a position perpendicular to the platform, regardless of events taking place in the economic market, because the movements of the pendulum are governed by the automatic, effective force of gravity. The pendulum will always tend to assume the most effective position because market effectiveness, as an immanent feature of the market, is the force of gravity that governs the economy.

Keynes, in contrast, argues that the pendulum often changes its position rather than tending to assume one effective position and why it is so remains the mystery of economics. The state has a duty to intervene in the motion of the pendulum and boost the economy through actions aimed at bringing the bob of the pendulum to the lowest point so that the pendulum is perpendicular to the platform.

Figure 1
Change in the economic paradigm



Source: Author's presentation.

[4] Andrew W. Lo, "The adaptive markets hypothesis: market efficiency from an evolutionary perspective," retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=602222.

Continuing with the interpretation assumed in the analogy presented in Figure 1, it should be noted that neoclassical and Keynesian economic studies did not emphasize the role of the moving and unstable base of the pendulum. As long as the platform moves in a straight line, with constant speed, and over level ground, the market is effective, and the pendulum tends to the effective point, in accordance with Friedman's theory. If, however, the market does not develop in straight-line, stable fashion, the pendulum will not achieve the expected position on its own. The developments on the financial markets in the twenty-first century have revealed a tendency toward destabilization as a result of new trends such as globalization and advances in new technologies used, for instance, to conduct multibillion transactions on the forex market.

The question thus arises as to what model of economic analysis adequately reflects the laws and the functioning of the market. The models presented above prove insufficient. Human emotions as a factor, the measurement of which has received a boost from research into emotional intelligence, can have a significant effect both on the movements of the pendulum and on the stability of the platform. Emotional intelligence consists of such human competencies as self-awareness (emotional self-awareness, self-assessment), self-regulation (trustworthiness, conscientiousness, achievement orientation, initiative), social awareness (empathy, political awareness), and social skills (influence, leadership, team capabilities, communication, change catalyst) (Goleman 1999). Methods for measuring IQ have been known and used for a long time; measurement models used to measure the emotional intelligence quotient (EQ) have also been developed (Mayer-Salovey-Caruso Emotional Intelligence Test). Interesting results have been obtained measuring both these complementary human competencies: people have various levels of each and no clear link can be established between the level of each kind of competency and the characteristics of the individual as a whole. The possibility of measuring and analyzing human emotional competencies is the point of departure for studies in behavioral economics, but its research scope is limited.

Figure 2
Change in the economic paradigm

Source: Author's presentation.

To an extent behavioral economics makes it possible to interpret why the bob of the pendulum sometimes behaves in a surprising manner, even when the platform remains stable, and why the platform may at times become unstable. It does not offer

an answer, however, as to how to prevent that happening. Kahneman's studies provide empirical analysis material that yields conclusions about the causes of human behavior without indicating what remedy to apply in order to secure rationally beneficial behaviors. The scope of the research only includes the decisions of individuals, excluding the entire range of interactions within groups, and their effect on the economic market or on the basic unit of that market, the firm. Generally, the shortcomings of behavioral economics stem from its focus on psychological experiments, with limited application of the research results to business entities, without offering conclusions applicable to the economic market at large. The present economic knowledge provides information on the evolution of entire markets (evolutionary economics) and on the decision-making processes of individuals (behavioral economics). What is missing from the whole body of knowledge and analysis is the basic unit: the business enterprise.

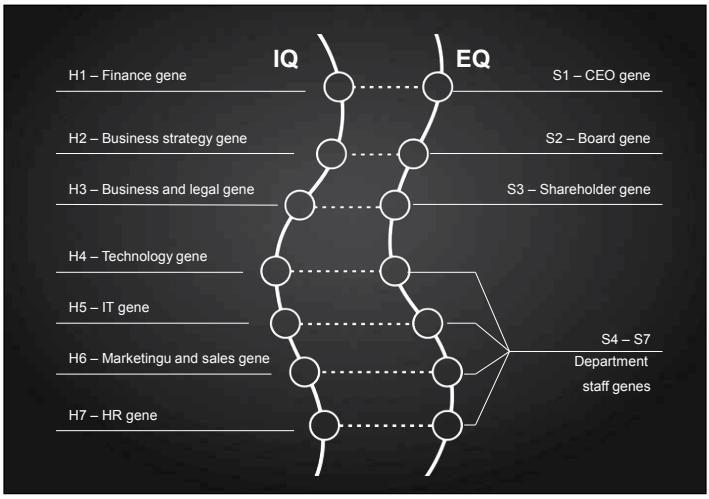
In addition to functioning in an environment of economic principles, enterprises are subject to the laws of the genetic theory of evolution. Based on an analysis of the Darwin–Wallace evolution theory, it can be demonstrated that firms, just like living organisms and populations in ecosystems, choose decision-making and investment strategies to maximize their chances of survival. There are strong analogies between the decision-making strategies of firms and strategies chosen by populations of living organisms as the most successful in evolution. In addition to their main goal, survival, evolutionary processes also have the aim of maintaining the stability of the ecosystems that provide an environment for the organisms and populations. An analogy can be drawn between the principles that make it possible to maintain the stability of ecosystems and those helping to maintain stability in the economic system.

Drawing on the genetic theory of evolution, I present my original model of firm DNA. The firm is the sum of elements making up its IQ: capital, balance sheet, earnings, the system of internal procures, marketing, and sales, as well as its EQ: human resources, cooperation between the employees, and the emotions that they bring with them to work daily. Figure 3 presents two chains of genes: the logical-mathematical chain of the enterprise, measurable in the process of due diligence (financials, strategies, technologies, IT systems), and another chain, relating to the people (shareholders, management, staff). Just like living organisms evolve and their genes undergo mutations, so do firms: for instance, when the capital gene is strengthened, the firm's chances of survival in the economic ecosystem increase. Personal changes at the senior management level are mutations resulting in a higher (better CEO) or lower (worse CEO) probability of survival (i.e. remaining liquid and maintaining market share) of the firm. The firm DNA model can be analyzed using the research apparatus applied to the investigation of living organisms under the genetic theory of evolution.

As shown in Figure 4, the emotional intelligence of a firm, or its EQ gene chain, comprises the knowledge and experience of each employee (the higher up in the organizational hierarchy a given person is, the greater the weight of this element) as well as the emotions of each member of the staff, which play

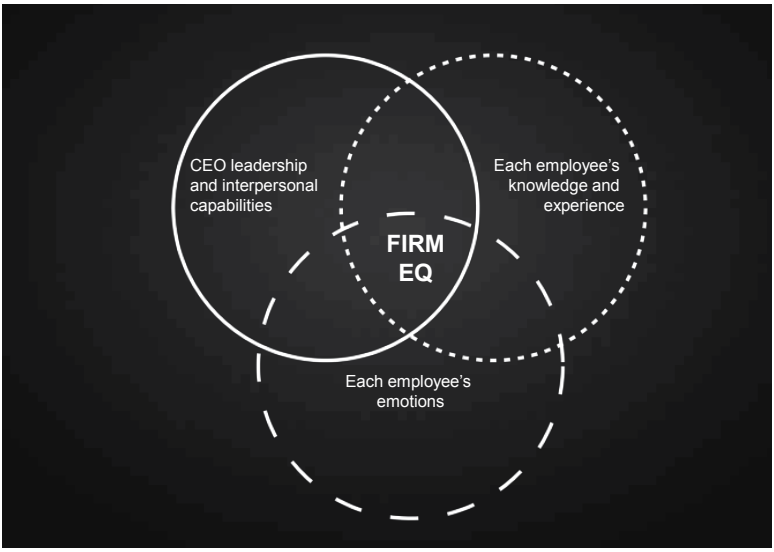
a huge role in the processes of decision making, often of strategic importance for the firm. Of key importance to the emotional intelligence of a firm are relations among the staff, which create the work atmosphere; the better it is, the more productive the work will be.

Figure 3
Firm DNA model



Source: Author's presentation.

Figure 4
Firm emotional intelligence (firm EQ)



Source: Author's presentation.

My model of firm DNA constantly evolving along with the entire economic ecosystem makes it possible to diagnose what is the survival paradigm for an enterprise. In biology, the purpose of individuals and populations is to pass the largest possible number of genes to future generations. The market process of natural selection is governed by the main principle, whether realized by firms or not, that the overarching purpose of an organization is to maintain net positive cash flows. Increasing the likelihood of being able to achieve net positive cash flows is the decisive and key factor determining whether an enterprise will continue as a going concern. Firm DNA mutations that increase the probability of net positive cash flows increase the firm's fitness (adaptation to the environment). By the same token, the process of natural selection will eliminate those entities whose chances of achieving net positive cash flows decrease.

Economic history is full of examples of enterprises that recognized accounting profits but lost liquidity and were forced into bankruptcy for lack of net positive cash flows. Under the Polish Commercial Companies Code, loss of liquidity by a firm obligates it to file for bankruptcy. Meanwhile, there are examples of firms showing accounting losses for years but maintaining positive operating results and net positive cash flows. One such example is the property development company Global Trade Center, which for many successive reporting periods recognized substantial impairments of real estate but with positive operating results and net positive cash flows was able to prosper on international markets.[5]

In the firm DNA model, mutations of individual genes contribute to attaining the aim of maintaining net positive cash flows. Mutations regarding emotional intelligence (S), such as replacement of staff with more productive employees or replacement of management with more competent managers, improve the organization's chances of survival. Mutations regarding academic intelligence (H), such as higher profitability, better technologies, or capital, likewise improve the organization's chances of survival. The firm DNA model enables the analysis and the root positioning of an organization's components that undergo continual mutations. In order to diagnose the condition of an organization and the scale of mutations, these factors must be measured. For emotional intelligence competencies, there are many established measurement methods. With regard to the soft tissue of the firm, its emotional DNA chain, the first method was CAMELS: a six-part system of bank appraisal used by the Fed as the US banking regulator.[6] One of the aspects that is measures is the quality of management, their relations within the organization, their adaptability, and their ability to make correct decisions

[5] GTC annual accounts for 2009–2012, retrieved from http://www.gtc.com.pl/ri/?s=okresowe-&lang=pl.

[6] CAMELS: C – Capital adequacy, A – Asset quality, M – Management quality, E – Earnings, L – Liquidity, S – Sensitivity to Market Risk; Jose A. Lopez, "Using CAMELS ratings to monitor bank conditions," FRBSF Economic Letter 1999-19, June 11, 1999, retrieved from http://www.frbsf.org/economic-research/publications/ economic-letter/1999/june/using-camels-ratings-to-monitor-bank-conditions/.

under stress. A similar system was put in place by the National Bank of Poland together with the Polish bank supervision authority: BION is the current system for the evaluation of financial institutions in Poland. A huge role in the context of measurement methods is played by rating agencies, whose main task is to evaluate the components of an enterprise and issue a rating. My own, original measurement model is the bank entropy evaluation method presented in my *Risk in Banking* the method emphasizes the strict correlation between entropy and organizational chaos and defines factors causing entropy to decrease: own capital, technological capital, and human capital (Czarnecki 2010). My entropy model is a matrix that can be used to measure the components of any organization.

The firm DNA model is proposed and an attempt is made to measure the evolution of its factors based on the analytical methods of the genetic theory of evolution of living organisms. Comparison of the two models, the firm DNA model and the structure and rules applicable to biological populations, leads to conclusions revealing numerous analogies, which corroborate the adequacy of the firm DNA model for the description of the phenomenon under consideration, that is the functioning of an enterprise in an economic system. In nature, the strategy of fear prevails over the strategy of greed. Both these primordial emotions, fear and greed, are side effects of evolutionary adaptation; their emergence contributed to improving man's chances of survival. That fear clearly prevails as a factor determining human behavior has been confirmed by game theory, by hypothesizing that faced with uncertainty over payoff an individual will not enter into a game.[7] The making of decisions motivated by strong fear of a loss is known to markets as the loss aversion effect. Stock market investors at all costs strive to avoid closing a position at a loss hoping for a change in the price of the financial instrument. They often refrain from entering into further transactions and do not count on a gain; they are paralyzed by fear to close a position in the red and book a loss. Fear is such a strong driver of investment behavior that investors do not make use of stop-loss options built into transaction systems. Fear of a loss was behind the maintenance of exposures taken by traders who caused losses for major institutions: Nick Leeson (Barings Bank 1995; loss: £827m), John Rusnak (Allied Irish Banks 2002; loss $691m), Jerome Kierwel (Société Générale 2006–2008; loss: €4.9bn), Boris Picano-Nacci (Caisse d'Epargne 2008; loss €751m), and Kweku Adoboli (UBS 2011; loss: $2.3bn).[8]

Another strategy confirming an analogy between the principles of evolution in biology and business is bet hedging, an evolutionary risk management strategy used by living organisms to adapt to a changing environment. In biology, this is exemplified by bird migrations: before departing for Africa, birds gather into one big flock only to then split into several smaller groups, thus diversifying risk

[7] The equilibrium theory of John Nash (Nobel Prize winner 1994).

[8] Andrew W. Lo, "Fear, greed, and financial crises: a cognitive neuroscience perspective," retrieved from http://ssm-vm026.mit.edu/finance/pdf/Lo-20120109d.pdf.

and maximizing the chance that at least a part of the flock will reach the destination safely and at least a part of the population will survive. In business, the diversification of revenues and expenses is the basis for shaping the operational structure of an enterprise.

Altruism occurs both in nature and in business, and it has a deep evolutionary sense. In biology, it may be illustrated with a bee colony, where only the queen has reproductive capabilities, but as worker bees share 50% of their genes with the queen, their altruistic behavior and their work for the queen are in effect advantageous as her offspring passes the genes of the workers to successive generations. Therefore, it is more advantageous both for individuals and for the group to favor altruistic behaviors by forgoing reproduction than to compete for drones.

Fairness as the most effective strategy offering the greatest evolutionary advantage occurs in the functioning of both biological populations and businesses. An experiment has been conducted in which a randomly chosen ape was given a bunch of bananas while the other members of the group got only one banana each. The group rejected and started to attack the ape that was unfairly given preferential treatment.

International expansion, a frequent business strategy, often leads to financial losses. Much can be learned from the swarming behavior of bees. To start a new colony, that is to expand, bees strategically select the most experienced workers and the strongest drones, i.e. the best members of their existing colony. Unfortunately, in business it is often the weakest managers, those who have not proved good enough at home, that are chosen to head foreign operations.

Herd behaviors are another analogy between biology and business. Such behavior is very well known from analyses of stock market investors' transactions. Another interesting analogy is the key role of the alpha male in both domains. A herd of animals will perish without a dominant alpha male, and likewise a business enterprise will fail without a key visionary leader.

Information and access to information are decisive for survival both in biology and in business. Quick access to complete and reliable information is key in today's global economy. The speed and transparency of information acquisition from the external environment and from inside the organization is often decisive for its survival on the market and makes possible immediate remedial action in the case of threats originating inside the firm. The firm's entropy is lowest when information is complete and provided to all process participants. The parallel in biology is a bee colony sending out workers-foragers in search of nectar. When successful foragers return with information about nectar location, a special bee dance is performed to provide the full information about the location of food resources. Transparency, speed, and communication of the information to all process participants – this is enviable in a business setting.

To sum up, the question to ask is how, using the above research results, can a firm protect itself against permanent market instability and ineffectiveness?

In the world of nature and living organisms, pain serves as the signal carrying information about a possible disease. In the world of business, a financial loss is such a warning sign. In Friedman's time, economic theory assumed that financial loss resulting from an erroneous business strategy was easy to correct thus making the market effective again; business practice was consistent with economic theory. However, in the twenty-first century, a change of a business decision and return to the path of growth and profitability depends on factors unknown in the nineteenth and the twentieth centuries: globalization and development of new technologies, In a world of global business using state-of-the-art technologies, new products (financial instruments) are launched on a mass scale at a rate unheard of in the history of economies. As a result of growing competition, not enough time is devoted to properly testing new products and services, which, using the latest IT technologies, can be implemented on a global scale. The process of developing, rolling out, and marketing products and services is a process directed by people burdened, as shown by behavioral economics, by a baggage of subconscious emotional archetypes encoded by evolution, and the results can be disastrous for individuals as well as for entire economies. For example, the crisis caused by the subprime credit speculative bubble in the USA in 2008, was due to the emergence of a very high-risk product, subprime asset-based securities, which could not be absorbed by the market owing to a limited volume of trading. When the supply of this product and the volume of trade rose substantially over just a few years, and when, as a result of the use of new technologies (high frequency trading), the product founds its way to dispersed portfolios all over the world, the market collapsed.

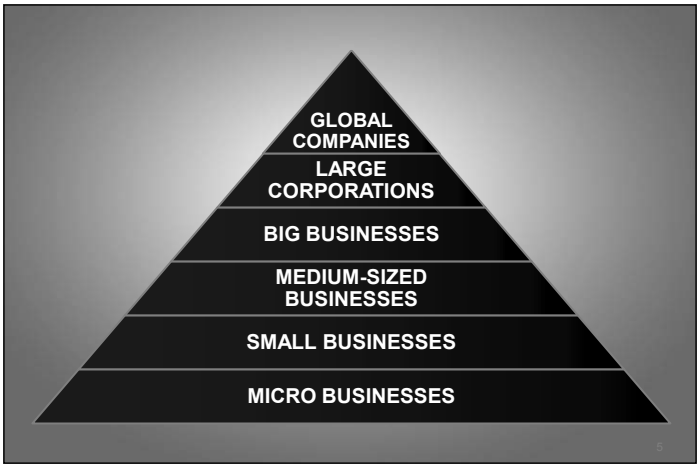
The proposed remedy to the problem of instantly rolled-out products is for enterprises to consciously slow down product launches and properly test newly launched products, especially financial, for potential risks. In the face of fast-changing IT solutions, it is necessary to concurrently develop risk evaluation methods and forward-looking models systemically foreseeing the effects of the decisions made.

The ecosystem in biology and the ecosystem in economics, i.e. the economic environment, show the same tendency: their stability to a large extent depend on the diversification and length of the food chain. Figure 5 shows the food chain pyramid of the economic ecosystem.

The stability of the system depends on the height of the pyramid and the size of the base, as the loss of one element will not result in the collapse of the whole system. The higher the pyramid and the larger the base, the more stable the system. In economic ecosystems, the base are small businesses, and the role of the state is to put in place such legislation as to ensure that the base is as large as possible. In a biological ecosystem, the sizes of living organisms are adjusted to the environment in which they live. In an economic ecosystem, the role of the state and the regulatory authorities is to put in place regulations to prevent the

growth of entities above the size supported by their environment; no enterprise or bank should grow to be "too big to fail." In a biological ecosystem, there is no place for the unlimited growth of one species; likewise, economic ecosystems did not absorb the growth banks whose total assets exceeded the GDP of their countries of origin. The banks that have been nationalized during the past five years in Europe had assets exceeding the GDP of their countries of origin. For a biological ecosystem, the dominance of one species is disadvantageous; similarly, in an economic ecosystem the dominance of one product gives rise to the risk of a speculative bubble.

Figure 5
Economic ecosystem



Source: Author's presentation.

An ecosystem has numerous limitations; therefore, economic regulations are necessary to ensure the stability of the ecosystem. The enforcement of the regulations is the task of regulators and politicians, who like all people make decisions based on their competencies of logical-mathematical intelligence and emotional intelligence. Consequently, the decisions carry the risk of irrationality, which is the subject of behavioral economics investigations.

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Summary

The article gives an overview of the main approaches to the analysis of market and economy laws that have evolved over the history of economic thought: neoclassical economics, Keynesianism, the Austrian/Chicago School, behavioral economics, and evolutionary economics, and reaches the conclusion that none of these theories alone is sufficient to account for various phenomena in the new economy of the 21st century, such as globalization or the development of new technologies. An original model of firm DNA is proposed, which can be used to analyze and measure the key compo-

nents of enterprise structure drawing on the achievements of behavioral economics. The view is presented that the firm and its components, functioning in an economic ecosystem, show similarities in the way they function and the tendencies they reveal to a population of living organisms in a biological ecosystem.

Keywords: behavioral economics, evolutionary economics, economic ecosystem, firm DNA model