The future is spontaneous, yet predictable*

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Albert László Barabási:
Bursts – The Hidden Patterns Behind Everything We Do,
from Your E-mail to Bloody Crusades
(Translated by János Kepes)
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As a result of the development of natural science, we now can model the movement of atoms with a high degree of accuracy, understand the repetitive nature of animals' eating habits or easily find out from the weather forecast whether it will rain the day after tomorrow. Although the world around us exhibits numerous regularities, we tend to believe that in the fast-paced world of the new millennium this does not apply to human actions at all. In most cases, we do not know in advance where we will spend next Saturday night, and perhaps we would find it offensive and even scary if someone stated that they knew with a certainty of 80 per cent what we would do exactly this minute a month later. Albert László Barabási, a Transylvanian-born Hungarian physicist and network researcher, points out in his book that most of us are far from being as spontaneous as we would like to believe: it is more difficult to predict the whereabouts of a bumble bee than that of any human being.

Barabási's book analyses the role of chance in human behaviour through the history of the peasants' war led by György Dózsa, while trying to find out whether the uprising was indeed predictable. The book closely follows the development of the uprising in 1514, mainly due to the prophecy of István Telegdi, the treasurer of King Ulászló II, who – according to the chronicle – forewarned the king and archbishop Tamás Bakócz of the bloody outcome of the crusade. Although the story, which runs for almost half of the book, relates to the work's narrower topic only tangentially, the alternation of the natural science and history chapters makes the book truly interdisciplinary.

* The views expressed in this paper are those of the author(s) and do not necessarily reflect the offical view of the Magyar Nemzeti Bank.

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As in his book *The New Science of Networks*, Barabási provides an insight into the development of his research results in *Bursts* as well, while at the same time illustrating through several examples how much luck one also needs for scientific inventions. We would know much less about the speed of virus propagation had the craze of tracking banknotes over the internet not spread, or the German Theodor Klauza would be known by everyone if Albert Einstein had been more quick to accept his five-dimensional space theory unifying gravity and electromagnetism in a single scheme. The book not only reveals the patterns of human behaviour, but also presents the results of key studies bringing us closer to it, along with the history of the creation of these patterns, which makes the book really interesting.

Based on the stories included in the book, we can assume that most natural science research is commenced by an idea occurring during friendly talks – or, in keeping with the title, a burst – as occurred with the research of the velocity of cash or the migration of albatrosses. Dirk Brockmann, a German physicist, learnt about the *wheres-george.com* site, registering the location of banknotes, from his friend in Vermont. Using this database, Brockmann found that, similarly to cash, the propagation of viruses also follow a Lévy flight, which may help to prevent the spread of epidemics in the future. Similarly, with the help of a database received from his cousin, Sergey Buldyrev found that the migration of albatrosses, which covers several thousands of kilometres without landing, may also be described by a Lévy flight, which could be concluded from the wet and dry signals of the detectors fastened to their legs. The question as to what degree the human behaviour can be described by the distributions observed in nature, and – if there are patterns in our actions similar to the propagation of cash or the migration of albatrosses – then to what extent they can be used for forecasting our future decisions, gradually unfolds in the book.

According to Barabási, human behaviour follows a number of patterns, due to which – in contrast to albatrosses or bumble bees – our future whereabouts can be estimated relatively well. Although we are affected by a number of new impulses every week, the actions of most people follow a similar pattern: on weekdays we get up at the usual time, we are at work from early morning to late afternoon, usually returning home thereafter. Although our weekend programmes can be very diverse, our behaviour can still be predicted relatively easily due to our daily routines. According to Barabási, due to our repetitive behaviour, the whereabouts of most of us follow a Gaussian distribution, as a result of which at any moment it can be estimated with an average certainty of 80 per cent where we are and what we are doing.

According to the book, although our actions can be forecast by normal distribution, power distribution is more suitable for the characterisation of the frequency of our activities. In contrast to migratory birds and cash, the average daily travel distance

covered by humans – due to our repetitive activity and permanent home – can be better described by the power distribution than by the Lévy distribution. Most of us stay in a district of a few kilometres on a daily basis, while others commute several hundreds of kilometres daily due to their work; but, contrary to the Lévy distribution, it is not typical of us to change our relatively narrow whereabouts on a monthly basis. Similarly to the travel distance of humans, the number of emails sent by us or the calls initiated from our phones also follow power distribution; however, what is much more interesting than that is the distribution of these over time.

Barabási points out that our repetitive actions are far from being accidental: they show bursts, hence they can be forecast similarly to our whereabouts. Our phone calls follow an abnormal distribution, as usually we make several subsequent calls followed by a pause of several hours – i.e. we may expect that if somebody initiates a call, very soon he will make several additional calls. Moreover, based on our actions in the past and our habits, the time elapsed between the bursts can be also predicted, thus it can be estimated with relatively high accuracy when we will make the next phone call.

On the whole, although we believe that it is spontaneous when we reach out for the phone, in fact – according to Barabási – in addition to our telephoning habits, a number of our repetitive actions also follow power distribution, and hence can be forecast with high accuracy. Our life is made more exciting by numerous bursts, but it appears from the book that these are far from being accidental: by obtaining deeper knowledge of the bursts the future may also become predictable some day.