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SUMMARY

The European Council for Modelling and Simulation (ECMS) has organised its interdisciplinary conference every year since 1986. The event is held in a different place each. With the exception of the conference in Kuala Lumpur in 2010, it has always taken place in Europe. For example, two year ago, just like in 1996, it was organised in Budapest. In 2019, the venue of the conference was the University of Campania Luigi Vanvitelli, next to the imposing royal palace of Caserta, close to Naples, where more than 30,000 students study.

It was a real interdisciplinary conference, as the presented 66 studies were not connected by discipline, but rather by the approach based on modelling and simulation. The conference programme included topics from the fields of natural sciences, technology, IT and social sciences. Some studies presented the results of fundamental research, but the results of applied research and specific case studies played an important role, as well. The two plenary presenters of the conference were *Alexander H. Lewis* (George Mason University – USA) and *Andrea Bobbio* (Amedeo Avogadro University – Italy). It is also worth mentioning that, for example, the keynote speech of the 2013 conference was given by a Norwegian neuroscientist, *May-Britt Moser*, who was awarded with a Nobel Prize in physiology one year later.

This report summarises the studies of the conference track for *Finance, Economics and Social Sciences*. Traditionally, the Hungarian presence has been very strong in this track. This year, it was even more dominant. Apart from the two studies presented by two Russian co-authors, all other lectures were given by teachers and students from Corvinus University of Budapest. By topic, the lectures can be divided into three main groups: lectures focusing on demographic, macrofinan-

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cial and microeconomic issues. Following the same logic, we will review the main points of the studies below.

Anna Bagirova and *Oksana Shubat* examined the change in fertility in Russian regions in both of their articles. Demographic processes are relevant both in social and economic terms. Economic policy measures aiming to encourage families to have children are in the focus in Russia, as well as in Hungary. The regional aspect is important, as even in a country whose size is similar to that of Hungary, the willingness to have children may significantly vary by territory. Of course, in considerably larger countries, this phenomenon is more conspicuous.

In their first presentation ("*Dynamics Modelling and the Study of Birth Rate Determinants in Russian Regions*"), the co-authors focused on the change in the total fertility rate by regions. The total fertility rate (TFR) indicates that based on current data on having children, how many children a woman is expected to bring to the world during her lifetime. In the 1990s, fertility rate significantly declined, mainly due to the regime change and the economic recession following the break-up of the Soviet Union. Later, it increased considerably in line with the starting economic growth between 2000 and 2006. Since 2007, the TFR has been increasing, but more slowly, despite the fact that the government seeks to increase willingness to have children by providing significant subsidies. Regional differences within the country may be interesting in this very respect, as their exploration may help the government to take more targeted measures. By means of cluster analysis, the 79 examined Russian regions can be divided into five groups. As regards the 1990s, there are no significant differences: a large drop in the TFR is observable in all the five clusters. The differences between the clusters become visible in the second and the third periods (2000–2006, since 2007). For example, in one group of the regions, the fertility rate has hardly increased since 2007. At the same time, in another cluster, the growth of the TFR has explicitly accelerated since 2007. In their study, the authors did not mention whether in terms of the social and economic characteristics of the individual regions there are patters which follow cluster formation based on the fertility rate.

Their second study ("*A Study of Regional Differentiation of the Fertility Resources Based on Convergence Models*") raised the question whether any convergence was observable among Russian regions in terms of indicators related to the so-called reproductive resources (infertility rate, the number of miscarriages per 1000 women of childbearing age, the number of miscarriages per 100 births) in the period between 2000 and 2017. The authors examined both beta-convergence and sigma-convergence. In the case of a variable, beta-convergence is observable among the regions, if the lower initial value of the variable in a region goes together with its higher rate of change in the examined period. By contrast, sigma-convergence refers to the decrease in the relative standard deviation in the given

variable. The relationship between the two terms can be defined as follows: beta-convergence ensues from sigma-convergence, but the reverse is not true. Regarding infertility, sigma-convergence does not show a clear picture. At the same time, slight beta-convergence is observable among the regions. On the other hand, as far as the number of miscarriages is concerned, the relative standard deviation shows a definitely growing tendency in the examined period. The lack of convergence also means that national measures aiming to increase the number of births through the reproductive resources are not effective enough. An approach focusing on regions or groups of regions would be more successful.

The study by *Erzsébet Kovács* and *Ágnes Vaskövi* (*"Living Longer. Working Longer? – Life Expectancy and Retirement Age Trends in OECD Countries"*) deals with another area of demography, examining the change of life expectancy and the average retirement age in the OECD countries. Of course, life expectancy and the average length of the retirement period are important regarding the pension system and the healthcare system, therefore they have direct budgetary impacts. Over the last few decades, life expectancy at birth has been increasing in the developed countries (by 5 years in the case of men and by 4 years in the case of women over the past 20 years). Life expectancy at the age of 65 has also been increasing, though at a more moderate pace. However, the data show that the effective retirement age, i.e. the average age when people retire, has been lagging behind the longer life expectancy: in the case of men, it has increased by 1.4 years on average, while in the case of women, by 1.8 years on average.

By means of Principal Component Analysis, the authors generated complex variables by gender from the data about life expectancy and the effective retirement age from 2015, respectively. As no correlation is observable between these variables, in general, it is not true that higher life expectancy in a given country brings about a longer active career. Based on the original variables, the authors also conducted a cluster analysis, which shows that the 35 examined OECD member states can be divided into four groups. The first group includes 12 countries (e.g. Israel, Japan, Sweden), where life expectancy and the effective retirement age are above-average. The 13 countries in the second group are characterised by similar demographic figures, however, the effective retirement age is significantly lower than in the first group. The third group includes five Central and Eastern European countries, where both life expectancy and the length of the active career are shorter than the average. The additional five countries in the fourth group (e.g. the USA, Mexico and Turkey) have relatively low life expectancy with fairly high effective retirement age. The classification of a country also determines the challenges it has to face in terms of the sustainability of the pension system and the stability of the financial situation of individuals.

Turning to the macrofinancial topics, firstly, *Erzsébet Varga* analysed the effects of an interesting tax policy option (*"Decreasing Progressive Tax Rates with Basic Income: The Golden Mean?"*): the effects of a progressive income tax in which marginal tax rates decrease instead of increasing. An income tax is progressive if a larger tax base means higher average tax rate. Provided the tax system is complemented with a lump-sum transfer (basic income, "negative tax"), we can talk about progressive taxation even if marginal tax rates are decreasing. In this case, the marginal tax rate of higher incomes should be higher than the average tax rate belonging to the income threshold between the tax brackets (that is significantly lower than the marginal tax rate belonging to lower income levels because of the transfer). Income tax debates are mostly about choosing between the flat-rate (linear) tax and the "regular" progressive taxation. However, it is worth examining the effects of the "irregular" progression described above, compared to the other two options.

The author compared three income tax systems, which result in the same tax revenue, in respect of income inequalities and the deadweight loss caused by taxes. One of these systems involved a linear tax of 15%. The other system was characterised by a "regular" progressive tax, with a marginal tax rate of 25% on lower incomes and a marginal tax rate of 45% on higher incomes. In the third tax system, the marginal tax rates are inverted: a marginal tax rate of 25% belongs to lower incomes, while that of 45% belongs to higher incomes. Of course, the second and the third cases are complemented with a considerable transfer, the amount of which depends on the income level used as the threshold between the tax brackets. Regarding social inequalities, it is observable that compared to the linear tax, even the "irregular" progression decreases net income disparities, though not to the same extent as "regular" progressive taxation. On the other hand, based on the author's findings, the former leads to less deadweight loss. In view of the above, progressive taxation implemented by means of decreasing marginal tax rates and a lump-sum transfer is between linear taxation and the "regular" progressive taxation in terms of both efficiency and equity, therefore it can be considered to be a kind of "golden mean".

Eszter Boros studied the changes in the price level of the Eurozone countries and their effects (*"A Fair Solution or Pure Theory: Price Adjustment in the EMU"*). The topic is relevant, because in the event of asymmetric shocks affecting the member states of a monetary union, the devaluation of the exchange rate aiming to improve competitiveness is not available to a negatively affected country. Instead, only the so-called internal devaluation is possible, which means that foreign trade positions can be improved (and through this the economy can be stimulated) by relatively decreasing the prices and the wages. However, it does not work unless prices and wages are flexible enough. The author analysed the data of the

Eurozone from the period of 2010–2017, on the one hand, in terms of the foreign trade price level, on the other hand, in terms of whether the change in the prices affected the competitiveness of the member states. In different country groups of the Eurozone, the export and import prices basically followed a similar path, however, in the Mediterranean countries and Ireland, the phenomenon of internal devaluation is still observable. On the one hand, the rise of the export prices was less significant or their decrease was more considerable than in other areas of the Eurozone. On the other hand, the difference between the import prices and the change in the domestic price level was greater, as well, which may lead to the replacement of import by domestic production.

Another question is whether the relative price changes really result in the improvement of competitiveness. In order to examine this, the decomposition of the change in exports is required. The total export change can be divided into three parts: firstly, the aggregate import demand is increasing in the target country, secondly, in the target country, there is an above-average increase in the demand for those product groups in which the examined country has a significant market share and, finally, the examined country is increasing its market share in the case of certain product groups. In fact, out of the above-mentioned three effects, only the third one means a real improvement in competitiveness. (A similar decomposition can be carried out in terms of imports, as well.) The author examines the relationship between foreign trade price level and the actual change in competitiveness with the methods of panel econometrics. Regarding exports, she comes to surprising results. Based on her findings, the decrease in export prices entailed real improvement of competitiveness only in the Mediterranean countries. In the case of other member states of the Eurozone, the relationship is rather reverse. In terms of import substitution, the result meets the expectations much better: the relative increase of the import prices compared to the domestic price level led to the increase of the market share of domestic producers indeed.

The study by *Ágnes Vidovics-Dancs*, *Péter Juhász*, *Nóra Szűcs* and *Gábor Hajnal* ("*How to Improve Your Sovereign Rating? – A Case Study on Hungary*") focuses on Fitch's credit rating model related to sovereign debts. Since the financial crisis, credit rating agencies have become more transparent. As part of this process, the agencies regularly publish methodological documentations and model descriptions. By means of these, the models applied by them can be more or less accurately reconstructed. Of course the results of the reconstructed models do not always reflect the real credit ratings. Firstly, not all information about the actual models and the used data is public. Secondly, the decisions made by the credit rating agencies may slightly differ from the results of the models they apply, for example, owing to the consideration of processes and phenomena that are dif-

ficult to quantify. Nonetheless, the analysis of the reconstructed models may lead to useful conclusions.

By reconstructing Fitch's model, the authors examined the effects of the changes in macro variables (GDP, money supply, inflation, gross government debt, foreign currency government debt) on sovereign credit rating. They conducted a partial analysis, focusing on how the rating changes if one or two macro data are affected by a shock, while the other data remain unchanged. Their analysis was based on the BBB- category, which was Hungary's rating at the time of writing the article. Based on this, the question of the study can be phrased as follows: What changes in the Hungarian figures are required for the improvement/deterioration of the country's credit rating. Regarding one-dimensional effects, it was found that upgrading would require the unrealistic improvement of some variables, while even a more realistic deterioration of the variables might result in downgrading. The results of the two-dimensional approach also show that even the simultaneous change in two relevant macro variables would probably not lead to the modification of the credit rating, not to mention its improvement.

The presentation by *Csaba Kádár* was about the topic of financial regulations (*"Is the Effect of Current Rules of International Accounting and Prudential Tools Make the Bank Reserving Pro-Cyclical? – Modelling of Impairment under IFRS 9 and Countercyclical Capital Buffer"*). He dealt with the effects of the more stringent new accounting and financial rules, as well as those of the countercyclical capital buffer regulation introduced by Basel III. The author modelled how IFRS 9 (International Financial and Reporting Standards) introduced in 2018 treated the problem of credit loss differently from the previous accounting system. Based on the results, the calculation system of IFRS 9 can take into account impairment caused by credit loss sooner and in a greater amount. After adding the regulation on countercyclical capital buffer to his model, he found that the overall effect of the introduction of new accounting and prudential regulations was countercyclical.

The study by *Ferenc Illés*, *Kira Muratov-Szabó*, *Andrea Prepuk*, *Melinda Szodorai* and *Kata Váradi* (*"Together Forever or Separated for Life: Stress Tests of Central Counterparties in Case of Merged and Separated Default Funds"*) is also related to the financial sector. They analysed the advantages and disadvantages of the situation in which a central counterparty linked to two markets operates merged or separated default funds in the individual markets. Their model included four clearing partners who can trade in two financial products (a share and a foreign currency) on the spot and derivative markets. One of them trades in the share only on the spot market, while the other three appear on both markets. The exchange rates of the financial products follow a stochastic process and are likely to be affected by certain shocks. In view of this, the margins to be paid by the

participants trading in different financial products and their contribution to the default fund can be calculated.

The authors conducted 101 simulations with regard to the prices of financial products. Based on the results of the simulations, the merged market is more advantageous for participants operating in both markets, because in this case, they can calculate with lower margins than in the case of two funds. At the same time, it is less advantageous for the participant who trades only on the spot market, because its relative contribution to the default fund increases compared to the others. From a prudential point of view, the system of separated markets is more favourable for the central counterparty, as higher contributions to default funds mean greater security if problems arise. However, higher margins make it more difficult for them to retain clients, in other words, they are disadvantageous in terms of competitiveness in the market.

The article by *Márta Fekete*, *András Olivér Németh*, *János Száz* and *Ágnes Vidovics-Dancs* (*"Simulating Bankruptcy – The Effects of Bailouts"*) connects two toolkits from different areas of economics. The authors received the Best Paper Award for presenting the best study of the conference. One of these instruments is the concept of soft budget constraint introduced by *János Kornai*. According to his definition, public companies and institutions are less encouraged to achieve effective management, as the government offers them a helping hand if any problem arises. We can interpret this possibility of bailout as an option, with the difference that the institution does not buy and call the option itself, but it receives it as a present from the government (or lobbies for it). Based on the above, the authors suggest that the toolkit of trinomial trees applied in option pricing could be used for the statistical analysis of questions related to bailouts.

The described model focuses on the liquidity situation of a hypothetical hospital. Within certain limits, this liquidity situation follows random walk with specified transition probabilities. If liquidity is lower than required, there is a possibility that the hospital will go bankrupt unless – with a certain probability – the government bails it out. In this framework, the authors examined how the hospitals' chance of survival depends on the probabilities of bankruptcy and bailout. In the rest of the study, the authors also raise the following question: in the case of two or more hospitals, to what extent does the chance of survival depend on whether the government concentrates its bailout resources only on one of them or it shares them between the hospitals. The simulation results based on the trinomial model suggest that the probability of the hospitals' bankruptcy is slightly higher in the latter case, but the main question is to what extent the liquidity situations of the hospitals correlate with each other.

Finally, the study by *Ildikó Gelányi*, *Péter Juhász* and *János Száz* (*"Delivery Risk in a Supply Chain with a Dominating Member: Modelling the Effect of the Inventory*

Policy") models an inventory problem which is becoming more and more important in today's economies based on supply chains. The problem is significant, because the competitiveness of a supply chain consisting of multiple companies considerably depends on the accuracy of deliveries between the members of the chain. In order to tackle delivery problems, the members of the chain may build up inventories, but the quantity of inventory optimal for certain companies may not necessarily be optimal for the whole supply chain. If the chain has a dominant member, this company may achieve that the other members of the chain also follow an inventory strategy optimal for the entire chain.

Their model describes a supply chain consisting of three companies. As for the dates of delivery between the companies, there is some uncertainty. Unexpected events might cause delays or early deliveries. Companies may decide to have an input inventory in accordance with delivery cycles based on the agreement or, due to the aforementioned uncertainties, they may build up an inventory that ensures higher security of supply. Of course, on the one hand, the latter generates extra costs, but it also increases the predictability of production regarding the entire supply chain, as it reduces the probability of the interruption of the production process at any point of the chain due to the temporary drying up of the input source. By means of simulations, the authors examined how the dominant participant of the supply chain with the highest revenue (if there is any) can achieve that the other members of the chain also opt for the accumulation of a larger inventory. More specifically, how high the margin should be to make companies feel that it is worth accumulating a larger inventory. The dominant participant can influence the margin, as the companies are each other's suppliers, therefore their agreed price is subject to bargaining. Of course, the actual results depend on which member of the supply chain is the dominant participant. In general, it can be established that mainly the companies in the first part of the chain have to be encouraged to pile up stocks more carefully by means of a higher margin. Building up a larger inventory is the optimal solution for the companies near the end of the chain even if the margin is low.

The short summaries above seek to highlight only the most important points of the studies without any technical details. Hopefully, even these summaries are enough to present the diversity of the economics session of the 2019 ECMS conference, regarding both the topics of the presentations and the selected methodologies.