

ECONOPHYSICS IN POLAND

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The development of econophysics in Poland over the last decade is presented. The research areas are discussed and the educational opportunities at Polish universities analysed. The role of the Section of Physics in Economy and Social Sciences of the Polish Physical Society is presented.

History

From a historical point of view econophysics roots in Poland, and in the world, could be dated back as early as the sixteenth century when the famous Polish astronomer Mikolaj Copernicus formulated the Copernicus-Gresham law which states that *bad money drives out good*¹. Shifting to modern times it is difficult to point out a single event which has initiated research in the field of econophysics in Poland. Among the world leaders of this interdisciplinary specialisation a special role for the econophysics in Poland has played prof. M. Ausloos from Liege University whose lectures on statistical physics application to financial analysis^{2,3} were a significant impact for Polish researches. Due to his contribution into econophysics development in Poland he was a special guest of the 3rd Polish Symposium on Econo- and Sociophysics, Wrocław 2007.

Certainly a milestone was the conference Application of Physics in Financial Analysis (APFA 4) which held at Warsaw University of Technology in 10-13 November 2003. The conference had a very good response among political leaders since the opening lecture was given by R. Kokoszczyński in the name of L. Balcerowicz, then President of the National Bank of Poland. Also at the time of the conference, two universities, namely the University of Silesia⁴ and the University of Wrocław⁵ had started to offer courses and diploma in econophysics. That conference has shown that in Poland there are several academic research groups working in the field of econophysics. In fact, the meeting played the role of a catalyst; besides being

an occasion to exchange scientific ideas it was also a chance to discuss problems of the society. The main conclusion of those discussions was that a formal organization representing interests of econophysicists was necessary. During the symposium a group of researchers representing the main university centres decided to submit an application to the Polish Physical Society to establish a new econo- and socio-physics section. This Society has accepted the application and on March 13, 2004 a new “Section of Physics in Economy and Social Sciences”⁶ was founded. The president of the section became Prof. J. Hołyst (Warsaw University of Technology). The first activity of the new section was to organise national econophysics meeting: The First Polish Symposium on Econo- and Sociophysics was held in Warsaw in 2004. The symposium was very successful with more than 90 participants. The presented materials were published in *Acta Physica Polonica B*⁷. The main areas of investigations were: time series analysis, network analysis, modelling of social interactions and risk theory. The success of the first symposium gave a prompt to continue the meetings and the following ones took places: in Kraków (2006), Wrocław (2007), Rzeszów (2009). In 2010, the fifth symposium is being organized in Warsaw again.

Research Area

The main university centres involved in econophysics investigations are in alphabetical order: Białystok, Gdańsk, Katowice, Kraków, Rzeszów, Warszawa (Warsaw) and Wrocław. Among them the most active ones seem to be in Warszawa, Kraków and Wrocław. Over the years the dominating study subject concerns financial time series analysis. The second area of interest pertains to the

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financial networks analysis and to the evolution of socioeconomic networks. Recently a growing interest is observed in applications of random matrix theory to economy problems. Classical mathematical subjects as theory of risk and portfolio optimization do not appear to be in the main stream of investigations. However they are usually presented in several lectures during Symposiums on Econo- and Sociophysics. It should be also pointed out that the scientists working on econophysics and sociophysics problems often cooperate, whence talks on sociophysics subjects are also usually presented during the Symposiums.

Institutional Scopes

As it has been mentioned econophysics investigations are carried out in Poland from the last years of the XX century, but still there is no econophysics department at any of Polish university. Research is usually affiliated with physics and mathematics departments or institutes. The most active ones are:

- Faculty of Physics of Warsaw University of Technology,
- Faculty of Physics of University of Warsaw,
- Institute of Theoretical Physics of University of Wrocław,
- Institute of Physics of Jagiellonian University,
- Faculty of Physics and Applied Computer Science of AGH University of Science and Technology,
- H. Niewodniczański Institute of Nuclear Physics of Polish Academy of Sciences,
- Institute of Physics of Polish Academy of Sciences,
- Institute of Theoretical Physics and Astrophysics of Gdańsk University, Faculty of Mathematics and Natural Sciences of Card. Stefan Wyszyński University,
- Institute of Physics of University of Rzeszów, Department of Econometrics and Informatics of Warsaw Agricultural University.

However as far the only institutional form strictly related to econophysics is the Section of Physics in Economy and Social Sciences at the Polish Physical Society.

Reports of the section activity can be found on its web page [6]. The main objectives of the section are

- The active promotion of interdisciplinary research by:
 - easing the cooperation between physicists, economists, sociologists and social psychologists,

- establishing cooperation of physics institutes and departments with institutions working in the areas of economy, sociology and social sciences as well as cooperation with governmental institutions,
- acquiring financial time series and exchange of data between research groups,
- assistance in gaining funds.
- Support of education in the field of econophysics.
- Organisation of conferences and meetings.

Study Opportunities

The first university in Poland which has offered the opportunity to study econophysics was the University of Silesia⁴. The licentiate (three years) studies in econophysics began in the academic year 2001/2002. Initially the courses were divided into 6 groups: physics (experimental and theoretical), mathematics/statistics, information technology, economy and management/ marketing. In principle after the econophysics students should have the possibility to continue studies either in physics or in management to obtain MA degree. While organizing the course University of Silesia have established close cooperation with ING - Bank Śląski, such that students were offered a complementary 1-month professional training. In the academic year (2009/2010) University of Silesia have extended their educational offer and students can also gain the MA degree in econophysics. Now at the licentiate stage students acquire knowledge in algebra, mathematical analysis, general and quantum physics, economy, general econophysics, probability and game theory, statistical analysis and econometric. During the second stage of education students learn advanced econophysics, computer models of market phenomena, decisions and negotiations in the game theory, statistical models in insurance and finance, theory of risk.

A different approach is presented at the University of Wrocław⁵. The 3 years econophysics course has been established due to the cooperation between two university departments, *i.e.* the Department of Physics and the Department of Economic Sciences. The first classes took place in the academic year 2002/2003. The main idea was to organize a fully interdisciplinary course in such a way that students could attend lectures given in both university departments and have an open choice in further postgraduate education. The students being B.Sc. graduates from econophysics have two opportunities for further training: the 4-semester course at a postgraduate level in the Department of Physics leading to a M.Sc. degree in physics or the same length postgraduate course in Department of

Economic Sciences leading to a Master in Economics (M.E.) degree. The main advantage of the course is that it offers a free choice for graduates between physics and economy.

The third university which offers econophysics specialisation is the Warsaw University⁸. Since 2006 there is a possibility to study “Methods of Physics in Economy” at the Faculty of Physics of the University of Warsaw. There are two educational paths: (i) the Master Degree Programme and (ii) the Bachelor Degree Programme with the possibility to continue further study towards a M.Sc. degree. However the second option is going to be in the future the only possibility to complete the study. The econophysics specialization, as in the case of the University of Wrocław, is organized in cooperation with the Faculty of Economy of the University of Warsaw. Similarly to the previously described courses the econophysics programme covers the following subjects: mathematics, economy, econophysics and computer sciences.

In general graduating students in econophysics are expected to: (i) have some competence to interpret the empirical data including analytical and numerical modelling as well as computer simulation, (ii) be able to observe and deal with physical and economical processes and phenomena, (iii) be capable for additional training or self-development related to the job, (iv) be able to collaborate within interdisciplinary teams.

Development Prognosis

Summarising the recent ten years of econophysics in Poland one must admit that researchers took advantage of the new field. Polish scientists are broadly recognised and participate in international conferences. The new section of Polish Physical Society have been established and finally at three universities there are possibilities to study econophysics. Among weak points we have to account that economists and physicists still have some reserve toward this interdisciplinary subject. The second defect is the lack of cooperation with financial and generally speaking commercial institutions. Despite significant development in the field there is very little cooperation between those institutions and econophysicists. However there is a hope that in line with the development of the financial institutions in Poland the situation will change and close cooperation between econophysics and industry will be established.

Meetings : The following econophysics conferences were organised in Poland in years 2000-2010:

1. Applications of Physics in Financial Analysis 4 (APFA 4), Warsaw 2003, Faculty of Physics,

Warsaw University of Technology
<http://www.if.pw.edu.pl/~apfa4/>⁹

2. First Polish Symposium on Econo- and Sociophysics, Warsaw 2004, Faculty of Physics of University of Warsaw, and Faculty of Physics of Warsaw University of Technology
<http://www.science24.com/event/fens2004/>¹⁰
3. Conference on Applications of Random Matrices to Economy and other Complex Systems, Kraków 2005, Mark Kac Complex Systems Research Center and EU Center of Excellence in Information Society Technologies “Copira” at the Institute of Physics, Jagiellonian University¹¹
4. Second Polish Symposium on Econo- and Sociophysics, Kraków 2006, Institute of Physics, Jagiellonian University and Faculty of Physics of AGH University of Science and Technology
<http://www.science24.com/event/fens2006/>¹²
5. Third Polish Symposium on Econo- and Sociophysics, Wrocław 2007, Institute of Theoretical Physics and Institute of Economical Sciences, University of Wrocław,
<http://www.science24.com/event/fens2007/>¹³
6. International Conference on Economic Science with Heterogeneous Agents (ESHIA / WEHIA 2008), Warsaw 2003 <http://science24.com/event/eshia2008/>
7. Forth Polish Symposium on Econo- and Sociophysics, Rzeszów 2009, Institute of Physics and Institute of Mathematics, University of Rzeszów, <http://www.science24.com/event/fens2009/>¹⁴. □

References

1. C. Kindleberger. *Comparative political economy*. (MIT Press), (2000).
2. M. Ausloos. Statistical Physics in Foreign Exchange Currency and Stock Markets. *Phys. A*, **285** : 48–65, (2000).
3. M. Ausloos. Empirical Analysis of Time Series. In W. Klonowski, editor, *From Quanta to Societies. Proceedings of the 2nd European Interdisciplinary School on Nonlinear Dynamics for System and Signal Analysis EUROATTRACTOR 2001*. (PABST Science Publishers), (2003).
4. J. Kisiel, S. Kowalski, E. Popiel, A. Ratuszna, B. Kożusznik, and S. Mielimka. Licentiate studies in econophysics at the University of Silesia. *Phys. A*, **344(1-2)**:340–343, (2004).
5. D. Grech. Econophysics teaching at the University of Wrocław. *Phys. A*, **344(1-2)**:335-339, (2004).
6. <http://ptf.fuw.edu.pl/fens/>.
7. *Acta Phys. Pol. B*, **36**, (2005).
8. R. Kutner and D. Grech. Report on Foundation and Organization of Econophysics Graduate Courses, at Faculty of Physics of University of Warsaw and Department of Physics and Astronomy of the Wrocław University. *Acta Phys. Pol. A*, **114** : 637–647, (2008).

9. J. Hołyst and M. Nowak, editors. *Application of Physics in Financial Analysis 4*, **344**. *Phys. A*, (2004).
10. R. Kutner and J. Hołyst, editors. *First Polish Symposium on Econo- and Sociophysics*, **36**. *Acta Phys. Pol. B*, (2005).
11. Z. Burda, J. Jurkiewicz, and M.A. Nowak, editors. *Conf. on Applications of Random Matrices to Economy and other Complex Systems*, **36**. *Acta Phys. Pol. B*, (2005).
12. Z. Burda, J. Hołyst, J. Jurkiewicz, K. Kułakowski, K. Malarz, M. Nowak, and K. Życzkowski, editors. *2nd Polish Symposium on Econo- and Sociophysics*, **37**. *Acta Phys. Pol. B*, (2006).
13. D. Grech, S. Drożdż, J. Hołyst, K. Kułakowski, and R. Kutner, editors. *3rd Polish Symposium on Econo- and Sociophysics*, **114**. *Acta Phys. Pol. A*, (2008).
14. S. Drożdż, K. Kułakowski, C. Mesjasz, and R. Rak, editors. *4th Polish Symposium on Econo- and Sociophysics*, **117**. *Acta Phys. Pol. A*, (2010).