Anna Bykhovskaya

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Employment

2019 – 2022 Juli Plant Grainger Postdoctoral Fellow,
UW Madison, Department of Economics

Education

PhD, Economics, Yale University, 2019
Dissertation: "Peer Effects: Theory and Measurement"
Advisors: Peter C.B. Phillips, Larry Samuelson

MA, MPhil, Economics, Yale University, 2016

MA, Economics, *Cum Laude*, New Economic School, 2013
Thesis: "Matching: The Role of Pre-match Investments"
Advisors: Efthymios Athanasiou, Sergei Izmalkov

BS, MS, Mathematics (with specialization in probability theory),
Summa Cum Laude (GPA 5.0/5.0), Moscow State University, 2012
Thesis: "Statistical Properties and Codings of (β, α)-Transforms"
Advisor: Valery Oseledets

Research Interests

Time Series Econometrics, Matching and Market Design, Networks

Publications

"Point Optimal Testing with Roots that are Functionally Local to Unity" (with Peter C.B. Phillips), *Journal of Econometrics*, 2018 (forthcoming)

"Boundary Limit Theory for Functional Local to Unity Regression" (with Peter C.B. Phillips), *Journal of Time Series Analysis*, Vol. 39, No. 4, 2018

Working papers

"Stability in Matching Markets with Peer Effects", submitted, 2018

"Evolution of Networks: Prediction and Estimation", submitted, 2019

Conference publications

"Limiting variance of (β, α)-transformations", *Proceedings of International Youth Scientific Forum "Lomonosov-2012"* (in Russian), 2012

"(β, α)-transformations and codings", *Proceedings of International Youth Scientific Forum "Lomonosov-2011"* (in Russian), 2011

Seminar and Conference Presentations

2018 *International Conference on Game Theory*, Stony Brook University, USA
2018 *Tripartite Conference*, Singapore
2018 *NYU Micro Theory Student Lunch*, New York University, USA
2017 *NES* 25*th Anniversary Conference*, Moscow, Russia

Grants and scholarships

Petr Aven Fellowship (2017 – 2018)
Falk Foundation Fellowship (2016 – 2017)
Besen and Dublier Fellowship (2014 – 2016)
Yale University Fellowship (2013 – 2019)
Cowles Fellowship (2013 – 2017)
NES alumni scholarship (2011 – 2012)
Grant RFBR-11-01-00982 a (2011 – 2012)
Scholarship of the Moscow city administration (2011 – 2012)

Teaching

Desired Teaching: Econometrics, Game Theory, Microeconomics

Yale University teaching fellow:

General Economic Theory: Microeconomics, Spring 2017 (graduate)

Intermediate Microeconomics, Spring 2016 (undergraduate)

General Economic Theory: Microeconomics, Fall 2015, 2016 (graduate)

New Economic School teaching fellow:

Game Theory, Winter 2013 (graduate)

Moscow School #57 teaching fellow:

Evening math study group, 2007 – 2008 (middle school)

Research and Work Experience

Research assistant to Larry Samuelson, Spring 2018
Research assistant to Florian Ederer, Spring 2015
Research assistant to Dirk Bergemann, Summer 2014
Member of the Russian translation group of the mathematical popularization website "Dimensions" `http://www.dimensions-math.org`

Referee Service: *Theoretical Economics*

Other

Citizenship: USA, Russia

Languages: Russian (native), English (fluent), French (beginner)

Software: C/C++, Gauss, Matlab, Mathematica, Stata, LaTeX

Dissertation Abstract

Peer effects are pervasive in human society, existing across the entire socio-politico-economic spectrum. Their presence affects decisions at the individual level and in policy making at industry and societal levels. My research is concerned with explaining the effect of existence vs. non-existence of these linkages, as well as their magnitude and potential emergence over time. I focus on two instances that are relevant in applications: matching markets and social or trade networks. The thesis contributes to the development of the micro-theory of equilibrium in the presence of peer effects and to the advancement of the econometric techniques to analyze the evolution of networks over time.

Evolution of Networks: Prediction and Estimation
The first part of the dissertation studies the effects that interactions may play in the prediction and estimation of socio-economic systems such as networks. Many interactive structures are not fixed over time and may be expected to evolve in systematic ways. The growing availability of time series data for social and economic networks makes it possible to model and estimate this evolution. My research develops such a modeling framework to study network evolution together with econometric procedures to estimate the parameters of the system. The estimates can be used to infer various properties of the structure and to make predictions about its future dynamics.
I build a multivariate time series system whose components can be interpreted as weighted edges of some network, and I treat the number of time periods as large compared to the size of the network. This framework differs from the usual cross section network formation or panel models that are currently in the literature. The

model is nonparametric with respect to the distribution of the errors and specifies the temporal evolution of a weighted graph that combines classical autoregression (AR) with non-negativity, a positive probability of vanishing, and peer effect interactions between weights assigned to edges in the process. These three distinguishing features are essential for network modeling, and we keep to the simplest possible model which has them. But even this model is non-linear in multiple ways that involve complications well beyond existing work on non-linear time series modeling.

My main results provide criteria for stationarity/explosiveness of the network evolution process and techniques for estimation of the parameters of the model and for prediction of its future values. The asymptotic theory is much more complex than that of the classical AR model and the results are novel in nonlinear time series modeling. Due to censoring, the naïve ordinary least squares (OLS) estimator for the parameters of the model is unreliable. But in this network AR setting an estimator based on minimization of the absolute deviations (LAD) is always consistent and is asymptotically normal in the stationary cases.

Natural applications arise in networks of fixed number of agents, such as countries, large corporations, or small social communities. The paper provides an empirical implementation of the approach to monthly trade data in European Union, where the number of countries is fixed and small. Computations show that the new model leads to improved performance over the most naïve (but standard benchmark) prediction that "tomorrow=today" in network evolution. Overall, the results confirm that incorporating non-negativity of dependent variables into the model matters and incorporating peer effects leads to the improved prediction power.

Stability in Matching Markets with Peer Effects

The presence of peer effects in schooling was first noticed more than fifty years ago and has subsequently been confirmed in many empirical studies. In economic theory the relationship between schools or colleges and students is usually modelled as a two-sided matching problem. Yet a challenge in matching models with peer effects is equilibrium existence. Despite much progress in the study of stable matchings in the presence of peer effects, there is still no simple criterion for existence that applies to a wide class of models.

My research takes a step in this direction. I consider an economy where agents are characterized by their types (e.g. SAT scores) and schools are characterized by their values (e.g. teaching quality) and capacities. Agents and schools are divided into groups, so that going to a school outside one's group may be associated with additional costs or even be prohibited. For example, religious schools generally accept only those students, who practice the same religion. Similarly, schools sometimes only accept those who live in pre-specified areas. Students receive utility from the school per se and from classmates. A key role in the analysis is played by a directed graph that governs the possibility to move from one group to another. I find that a sufficient condition for a stable matching to exist is that the graph should not have (directed or undirected) cycles. Under these conditions, I construct a polynomial time algorithm for finding a stable matching. Acyclicity ensures that the algorithm must terminate. While non-directed cycles do not play a major role in previous work, here they are of the same importance as directed cycles. Furthermore, I show that if the graph has a cycle, then there exist other economic parameters (types, costs and so on) so that no stable matching exists.