SIS2016

Università degli Studi di Salerno

June 8th – June 10th, 2016

PROCEEDINGS

of the 48th scientific meeting of the
Italian Statistical Society

Editors: Monica Pratesi and Cira Pena

ISBN: 9788861970618

PLENARY SESSIONS

(A) E. Baldacci — Financial Crises and their Impacts: Data Gaps and Innovation in Statistical Production.

(B) D. Dunson — Probabilistic inference from big and complex data.

(C) S. Strozza — Foreign immigration in Italy: a forty-year-old history.

SPECIALIZED SESSION (SPE)

(SPE-01) Inference, sampling and survey design

P. Conti — Resampling from finite populations under complex designs: the pseudo-population approach. (Co-author(s): F. Andreis, D. Marella, F. Mecatti)

P. Righi — A joint use of model based and design based frameworks for defining optimal sampling designs. (Co-author(s): P. D. Falorsi)

A. Ruiz-Gazen — A unified approach for robustness in survey sampling. (Co-author(s): J. Beaumont, D. Haziza)

(SPE-02) Multivariate models for risk assessment

M. Billio — A Bayesian nonparametric approach to macroeconomic risk. (Co-author(s): R. Casarin, M. Costola, M Guindani)

P. Cerchiello — Bank risk contagion:an analysis through big data. (Co-author(s): P. Giudici, G. Nicola)

L. De Angelis — A Markov-switching regression model with non-Gaussian innovations for systemic risk measurement. (Co-author(s): C. Viroli)

(SPE-03) Bayesian nonparametrics

D. Durante — Bayesian Nonparametric Modeling of Dynamic International Relations. (Co-author(s): D. Dunson)

A. Guglielmi — Bayesian autoregressive semiparametric models for gap times of recurrent events. (Co-author(s): G. Paulon, M. De Iorio)

A. Rodriguez — Restricted Nonparametric Mixtures models for Disease Clustering. (Co-author(s): T. Xifara)

(SPE-04) Statistical methods for the analysis of gene-environment interaction in the study of complex pathologies

C. Angelini — An introduction to next generation sequencing for studying omic-environment interactions.

L. Calciano — Statistical approaches for the evaluation of genetic associations in complex diseases: the heterogeneity of asthma phenotypes. (Co-author(s): L. Portas, S. Accordini)

Y. Pankaj — Improved case-only approach to study genome-wide gene-environment interaction. (Co-author(s): S. Freitag-Wolf, A. Dempfle, W. Lieb, M. Krawczak)

(SPE-05) Nonlinear time series

M. Niglio — Probabilistic properties of Self Exciting Threshold Autoregressive processes. (Co-author(s): F. Giordano, C. D. Vitale)

T. Proietti — Optimal prediction of stochastic trends. (Co-author(s): A. Giovannelli)

H. Tong — On model selection from a finite family of possibly misspecified models. (Co-author(s): H. Hsu, C. Ing)

(SPE-06) Spatial analyses in demography

F. Heins — Measuring residential segregation with spatial indices: an appraisal and applications for the metropolitan area of Rome. (Co-author(s): F. Benassi, F. Lipizzi, E. Paluzzi)

A. Mazza — Immigrants' settlement patterns in the city of Naples. (Co-author(s): G. Gabrielli, S. Strozza)

L. Natale — Native Immigration and Pull Factor Evolution in Italy: a Spatial Approach. (Co-author(s): A. Santacroce, F. G. Truglia)

(SPE-07) Recent developments in Volatility modeling

R. Casarin — Dynamic Model Averaging for Quantile Regression. (Co-author(s): M. Bernardi, B. Maillet, L. Petrella)

A. Rahbek — Testing volatility: consistency of bootstrap testing for a parameter on the boundary of the parameter space.

E. Ruiz — Asymmetric Stochastic Volatility Models: Properties and Estimation. (Co-author(s): V. Czellar, X. Mao, H. Veiga)

(SPE-08) Advances in ordinal contingency table analysis

L. D'Ambra — Dimensionality reduction methods for contingency tables with ordinal variables. (Co-author(s): P. Amenta, A. D'Ambra)

R. Lombardo — Modelling Trends in Ordered Three-Way Non-Symmetrical Correspondence Analysis. (Co-author(s): P. Kroonenberg, E. Beh)

M. Riani — Using Collapsing and Multiple Comparisons to Detect Association in Two Way Contingency Tables. (Co-author(s): S. Arsenis)

(SPE-09) Statistical models for directional and circular data

C. Ley — The WeiSSVM: a tractable, parsimonious and flexible model for cylindrical data.

G. Mastrantonio — The multivariate projected-skew normal distribution: Bayesian estimation and a hidden Markov model application.

A. Panzera — Circular density estimation via matching local trigonometric moments. (Co-author(s): M. Di Marzio, S. Fensore, C. C. Taylor)

(SPE-10) The interplay between frequentist and bayesian inference

C. Grazian — Classical inference for intractable likelihoods.

J. Hannig — Fusion learning for Interlaboratory Comparison. (Co-author(s): Q. Feng, H. Iyer, C. Wang, X. Liu)

F. Pauli — p-value in science: a review of issues and proposed solutions.

(SPE-11) Société Française de Statistique

B.H. Avner — Stochastic Block Model for Multiplex network: an application to a multilevel network of researchers..

Y. Bennani — Nonnegative Matrix Factorization for Transfer Learning. (Co-author(s): I. Redko)

T. Laloe — Detection of dependence patterns with delay.

J. Poggi — Disaggregated Electricity Forecasting using Wavelet-Based Clustering of Individual Consumers. (Co-author(s): J. Cugliari, Y. Goude)

(SPE-12) National accounts

A. Coli — The European Welfare State in times of crisis according to macroeconomic official statistics. (Co-author(s): E. Micheletti, B. Pacini)

C. Martelli — National Account and Open Data: a new semantic approach.

G. Oneto — New information contents of the National Accounts for the monitoring of the economic situation.

(SPE-13) Statistical tools for monitoring the educational system and assessing students' performances

L. Grilli — Evaluation of university students' performance through a multidimensional finite mixture IRT model. (Co-author(s): S. Bacci, F. Bartolucci, C. Rampichini)

G. Leckie — Monitoring school performance using value-added and value-table models: Lessons from the UK.

P. Sarnacchiaro — A statistical model to assess teacher performance. (Co-author(s): I. Camminatiello, R. Palma)

(SPE-14) Robust inference by bounded estimating functions

A.C. Monti — M Estimation based Inference for Ordinal Response Model.

E. Ruli — Approximate Robust Bayesian Inference with an Application to Linear Mixed Models. (Co-author(s): N. Sartori, L. Ventura)

J. Valeinis — Some robust methods using empirical likelihood for two samples. (Co-author(s): M. Velina, E. Cers, G. Luta)

SOLICITED SESSION (SOL)

(SOL-01) Subjective wellbeing and demographic events over the life course

G. Fuochi — Cultural and institutional drivers of basic psychological needs satisfaction. (Co-author(s): P. Conzo, A. Aassve, L. Mencarini)

L. Mencarini — Five reasons to be happy about childbearing. (Co-author(s): A. Aassve, F. Luppi)

B. Nowok — Migration motivations and migrants' satisfaction in the life course: A sequence analysis of geographical mobility trajectories in the United Kingdom.

A. Pirralha — Does becoming a parent change the meaning of happiness and life satisfaction? Evidence from the European Social Survey. (Co-author(s): H. Dobewall)

(SOL-02) Statistics for equitable and sustainable development

E. di Bella — Wellbeing and sustainable development: a multi-indicator approach to evaluate urban waste management systems. (Co-author(s): B. Cavalletti, M. Corsi)

C. Giusti — Small Area Estimation for Local Welfare Indicators in Italy. (Co-author(s): S. Marchetti, L. Faustini, L. Porciani)

T. Laureti — Does socio-economic variables influence the Italians' adherence towards a sustainable diet?. (Co-author(s): L. Secondi)

F. Riccardini — Sustainability of wellbeing: an analysis of resilience and vulnerability through subjective indicators. (Co-author(s): M. Bachelet, F. Maggino)

(SOL-03) New approaches to treat undercoverage and nonresponse

F. Andreis — Methodological perspectives for surveying rare and clustered population: towards a sequentially adaptive approach.

E. Furfaro — Dealing with under-coverage bias via Dual/Multiple Frame designs: a simulation study for telephone surveys.

D. Haziza — Weight adjustment procedures for the treatment of unit nonresponse in surveys. (Co-author(s): É. Lesage)

E. Kabzinska — Empirical likelihood multiplicity adjusted estimator for multiple frame surveys. (Co-author(s): Y. G. Berger)

(SOL-04) Statistical models and methods for network data

M. Cugmas — Measuring stability of co-authorship structures in time. (Co-author(s): A. Ferligoj)

J. Koskinen — A dynamic discrete-choice model for movement flows. (Co-author(s): T. Mueller, T. Grund)

G. Ragozini — Prototyping and Comparing Networks through Archetypal Analysis. (Co-author(s): D. De Stefano, M.R. D'Esposito)

S. Zaccarin — Modeling network dynamics: evidence from policy-driven innovation networks. (Co-author(s): A. Caloffi, D. De Stefano, F. Rossi, M. Russo)

(SOL-05) Recent developments in computational statistics

R. Argiento — A conditional algorithm for Bayesian finite mixture models via normalized point process.

S. Favaro — Thompson sampling for species discovery. (Co-author(s): M. Battiston, Y. Teh)

A. Mira — An application of Reinforced Urn Process to advice network data. (Co-author(s): S. Peluso, P. Muliere, F. Pallotti, A. Loni)

N. Sartori — Bootstrap prepivoting in the presence of many nuisance parameters. (Co-author(s): R. Bellio, I. Kosmidis, A. Salvan)

(SOL-06) Statisticians meet naturalists: issues on ecological and environmental statistics

F. Ferretti — Estimating the abundance of wildlife ungulate populations in Mediterranean areas: methods, problems and findings. (Co-author(s): A. Sforzi)

M. Ferretti — The monitoring of forests in Europe: methods, problems and proposals.

D. Rocchini — The power of generalized entropy for biodiversity assessment by remote sensing: an open source approach. (Co-author(s): L. Delucchi, G. Bacaro)

(SOL-07) From survey data to new data sources and big data in official statistics

G. Barcaroli — Machine learning and statistical inference: the case of Istat survey on ICT. (Co-author(s): G. Bianchi, R. Bruni, A. Nurra, S. Salamone, M. Scarnò)

S. Falorsi — Forecasting Italian Youth Unemployment Rate Using Online Search Data. (Co-author(s): S. Loriga, A. Naccarato, A. Pierini)

B. Liseo — Bayesian nonparametric methods for record linkage. (Co-author(s): A. Tancredi)

T. Tuoto — Exploring solutions for linking Big Data in Official Statistics. (Co-author(s): L. Di Consiglio, D. Fusco)

(SOL-08) Symbolic data analysis methods and applications

E. Diday — Explanatory and discriminatory power of variables in Symbolic Data Analysis.

M.B. Ferraro — Fuzzy and possibilistic approach to clustering of imprecise data. (Co-author(s): P. Giordani)

L. Grassini — Symbolic data analysis approach for monitoring the stability of monuments.. (Co-author(s): B. Bertaccini, G. Biagi, A. Giusti)

M. Ichino — Similarity and Dissimilarity Measures for Mixed Feature-type Symbolic Data. (Co-author(s): K. Umbleja)

(SOL-09) Compositional analysis

L. Crosato — Forecasting CPI weights through compositional VARIMA: an application to Italian data.. (Co-author(s): F. Lovisolo, B. Zavanella)

J. A. Martín-Fernández — Understanding association rules from a compositional data approach. (Co-author(s): M. Vives-Mestres, R. Kenett)

A. Menafoglio — Object Oriented Geostatistical Simulation of Functional Compositions via Dimensionality Reduction in Bayes spaces. (Co-author(s): A. Guadagnini, P. Secchi)

V. Simonacci — Fitting CANDECOMP-PARAFAC model for compositional data: a combined SWATLD-ALS algorithm. (Co-author(s): M. Di Palma, V. Todorov)

(SOL-10) Sustainable development: theory, measures and applications

F. Riccardini — Measuring sustainable development goals from now to 2030.

F. Riccardini — How the nexus of food/water/energy can be seen with the perspective on well-being of people and the Italian BES framework. (Co-author(s): D. De Rosa)

T. Rondinella — An innovative methodology for the analysis of sustainability, inclusion and smartness of growth through Europe2020 indicators.. (Co-author(s): E. Grimaccia)

P. Ungaro — The Italian population behaviours toward environmental sustainability: a study from Istat surveys. (Co-author(s): I. Mingo, V. Talucci)

(SOL-11) Detecting heterogeneity in ordinal data surveys

E. Di Nardo — CUB models: a preliminary Fuzzy approach to heterogeneity. (Co-author(s): R. Simone)

S. Giordano — Modelling uncertainty in bivariate models for ordinal responses. (Co-author(s): R. Colombi, A. Gottard, M. Iannario)

M. Manisera — Treatment of "don't know" responses in rating data: effects on the heterogeneity of the CUB distribution. (Co-author(s): P. Zuccolotto)

F. Pennoni — Modelling a multivariate hidden Markov process on survey data.

(SOL-12) Active ageing: age management and lifelong learning strategies

P. E. Cardone — Age management in Italian companies. Findings of two Isfol surveys. (Co-author(s): M. Aversa, L. D'Agostino)

A. Lorenti — Working after Retirement in Europe.

C. Polli — Older low-skilled workers and economic crisis in Italy. (Co-author(s): R. Angotti)

G. Rivellini — Population ageing and human resources management. A chance for Applied Demography. (Co-author(s): F. Marcaletti, F. Racioppi)

(SOL-13) Statistical models for evaluating policy impact

M. Bia — Evaluation of Training Programs by exploiting secondary outcomes in Principal Stratification frameworks: the case of Luxembourg. (Co-author(s): F. Li, A. Mercatanti)

G. Cerulli — Testing Stability of Regression Discontinuity Models. (Co-author(s): Y. Dongz, A. Lewbel, A. Poulsen)

R. P. Mamede — Counterfactual Impact Evaluation of Vocational Education in Portugal. (Co-author(s): D. Cruz, T. Fernandes)

G. Pellegrini — Italian public guarantees to SME: the impact on regional growth. (Co-author(s): M. De Castris)

(SOL-14) Usage of geocoded micro data in the economic analysis

M. Dickson — Spatial sampling methods with locational errors. (Co-author(s): D. Filipponi)

D. Giuliani — Spatial Micro-Econometrics Models with Locational Errors. (Co-author(s): S. Cozzi, G. Espa)

F. Santi — Three-Year Survival Probability of Italian Start-up Businesses in Healthcare Industry: an Empirical Investigation through Logistic Multilevel Modelling. (Co-author(s): M. M. Dickson, D. Giuliani, D. Piacentino)

(SOL-15) Statistical models in functional data analysis

G. Adelfio — Space-time FPCA Algorithm for clustering ofmultidimensional curves. (Co-author(s): F. Di Salvo, M. Chiodi)

C. Miller — Functional data analysis approaches for satellite remote sensing applications. (Co-author(s): R. O'Donnell, M. Gong, M. Scott)

E. Romano — Order statistics for spatially dependent functional data. (Co-author(s): A. Balzanella, R. Verde)

L. M. Sangalli — A penalized regression model for functional data with spatial dependence. (Co-author(s): M. S. Bernardi, G. Mazza, J. O. Ramsay)

(SOL-16) Forecasting economic and financial time series

G. Goracci — Asymptotics and power of entropy based tests of dependence for categorical data. (Co-author(s): S. Giannerini)

M. M. Pelagatti — Forecasting electricity load and price: a comparison of different approaches. (Co-author(s): F. Lisi)

G. Storti — Flexible Realized GARCH Models. (Co-author(s): R. Gerlach)

(SOL-17) Immigrations and integration in Italy

O. Casacchia — Minorities internal migration in Italy: an analysis based on gravity models. (Co-author(s): C. Reynaud, S. Strozza, E. Tucci)

C. Conti — Growing generations and new models of integration.

N. Tedesco — Measurement of segregation in the labour market. An alternative approach. (Co-author(s): L. Salaris)

L. Terzera — Family behaviours among first generation migrants. (Co-author(s): E. Barbiano di Belgiojoso)

(SOL-18) Open data, linked data and big data in public administration and official statistics

G. Di Bella — Linked Administrative Data in Official Statistics: a Positive Feedback for the Quality?. (Co-author(s): G. Garofalo)

C. Martelli — Generating high quality administrative data: new technologies in a national statistical reuse perspective. (Co-author(s): M. Calzaroni, A. Samaritani)

V. Santarcangelo — An innovative approach about the analysis of quality and efficiency in Italian law. (Co-author(s): A. Buondonno, A. Romano, M. Giacalone, C. Cusatelli)

B. Squittieri — Prato municipality experience towards a high integration between administrative and statistical data.

(SOL-19) Evaluation of prognostic biomarkers

F. Ambrogi — Combining Clinical and Omics data: hope or illusion?. (Co-author(s): P. Boracchi)

L. Antolini — Graphical representations and summary indicators to assess the performance of risk predictors. (Co-author(s): D. Bernasconi)

P. Chiodini — Multivariable prognostic model: external validation and model recalibration with application to non-metastatic renal cell carcinoma. (Co-author(s): L. Cindolo)

(SOL-20) Models for studying the mobility of students

S. Balia — Modelling inter-regional patient mobility: evidence from the Italian NHS. (Co-author(s): R. Brau, E. Marrocu)

A. D'Agostino — University mobility at enrollment: geographical disparities in Italy. (Co-author(s): G. Ghellini, S. Longobardi)

M. Enea — From South to North? Mobility of Southern Italian students at the transition from the first to the second level university degree.

F. Giambona — Measuring territory student-attractiveness in Italy. Longitudinal evidence.

CONTRIBUTED SESSION (CON)

(CON-01) Bayesian statistics (1)

F. Giummolè — Reference priors based on composite likelihoods. (Co-author(s): V. Mameli, L. Ventura)

B. Nipoti — On Bayesian nonparametric inference for discovery probabilites. (Co-author(s): J. Arbel, S. Favaro, Y. W. Teh)

R. Pappadà — Relabelling in Bayesian mixture models by pivotal units. (Co-author(s): L. Egidi, F. Pauli, N. Torelli)

C. Scricciolo — On Deconvolution of Dirichlet-Laplace Mixtures.

(CON-02) Statistical modeling

P. Faroughi — A New Bivariate Regression Model for Count Data with Excess Zeros. (Co-author(s): N. Ismail)

B. Francis — Dynamic latent class profiles in cross-sectional surveys: some preliminary results. (Co-author(s): V. Hoti)

P. M. Kroonenberg — The use of deviance plots for non-nested model selection in loglinear models, structural equations, three-mode analysis.

A. Lucadamo — Variable selection through Multinomial LASSO for PCMR. (Co-author(s): L. Greco)

O. Paccagnella — Integrating CUB Models and Vignette Approaches. (Co-author(s): S. Pavan, M. Iannario)

(CON-03) Demographics and social statistics (1)

D. Bellani — Gender egalitarianism, education and life-long singlehood: A multilevel analysis. (Co-author(s): G. Esping-Andersen, L. Nedoluzhko)

L. Colangelo — Fear of Crime and Victimization among Sexual Harassed Women: Evidence from Italy. (Co-author(s): P. Mancini)

S. De Cantis — A survival approach for the analysis of cruise passengers' behavior at the destination. (Co-author(s): M. Ferrante, A. Parroco, N. Shoval)

A. Di Pino — Retirement of the Male Partner and the Housework Division in the Italian Couples: Estimation of the Causal Effects. (Co-author(s): M. Campolo)

F. Lariccia — Many women start, but few continue: determinants of breastfeeding in Italy. (Co-author(s): A. Pinnelli)

(CON-04) Environmental statistics

F. Bono — Measuring sustainable economic development through a multidimensional Gini index. (Co-author(s): M. Giacomarra, R. Giaimo)

C. Calculli — Modeling multi-site individual corals growth. (Co-author(s): B. Cafarelli, D. Cocchi, E. Pignotti)

F. Di Salvo — GAMs and functional kriging for air quality data. (Co-author(s): A. Plaia, M. Ruggieri)

F. Durante — The Kendall distribution and multivariate risks.

(CON-05) Health statistics

E. di Bella — Dental care systems across Europe: the case of Switzerland. (Co-author(s): L. Leporatti, I. Krejci, S. Ardu)

F. Gasperoni — Multi-state models for hospitalizations of heart failure patients in Trieste. (Co-author(s): F. Ieva, G. Barbati)

F. Grossetti — Multi-state Approach to Administrative Data on Patients affected by Chronic Heart Failure. (Co-author(s): F. Ieva, S. Scalvini, A. M. Paganoni)

G. Montanari — Evaluation of health care services through a latent Markov model with covariates. (Co-author(s): S. Pandolfi)

(CON-06) Labor market statistics

A. Bianchi — Multifactor Partitioning: an analysis of employment and firm size. (Co-author(s): S. Biffignandi)

G. Busetta — Ugly Betty looks for a job. Will she ever find it in Italy?. (Co-author(s): F. Fiorillo)

G. Busetta — No country for foreigners: an analysis of hiring process in Italian labor market. (Co-author(s): M. Campolo, D. Panarello)

F. Crippa — Know your audience. Towards a partnership between employers and university. (Co-author(s): M. Zenga)

I. Vannini — Online Job Vacancies: a big data analysis. (Co-author(s): D . Rotolone, C. Di Stefano, A. P. Paliotta, D. F. Iezzi)

(CON-07) Robust statistics

F. Greselin — Robust estimation of mixtures of skew-normal distributions. (Co-author(s): L. García-Escudero, A. Mayo-Iscar, G. McLachlan)

M. Musio — Renyi's Scoring Rules. (Co-author(s): A. F. Dawid)

A. Paganoni — Robust classification of multivariate functional data. (Co-author(s): F. Ieva)

G. C. Porzio — A robust estimator for the mean direction of the von Mises-Fisher distribution. (Co-author(s): T. Kirschstein, S. Liebscher, G. Pandolfo, G. Ragozini)

F. Palumbo — Robust Partial Possibilistic Regression Path Modeling. (Co-author(s): R. Romano)

(CON-08) Sampling methods

A. Ghiglietti — Adaptive Randomly Reinforced Urn design and its asymptotic properties.

D. Marella — PC algorithm from complex sample data. (Co-author(s): P. Vicard)

S. Missiroli — Optimal Adaptive Group Sequential Procedure for Finite Populations in the Presence of a Cost Function. (Co-author(s): E. Carfagna)

E. Pelle — The Rao regression-type estimator in ranked set sampling. (Co-author(s): P. Perri)

M. Ruggiero — Modelling stationary varying-size populations via Polya sampling. (Co-author(s): P. De Blasi, S. Walker)

(CON-09) Economic data analysis

M. Brunetti — Getting older and riskier: the effect of Medicare on household portfolio choices. (Co-author(s): M. Angrisani, V. Atella)

E. Ciavolino — Modelling the Public Opinion on the European Economy with the HO-MIMIC Model. (Co-author(s): M. Carpita)

G. D'Epifanio — Indexing the Worthiness of Social Agents. To norm index on conventional specifications.

G. Guagnano — An econometric model for undeclared work. (Co-author(s): M. Arezzo)

M. Mussini — A spatial shift-share decomposition of energy consumption variation. (Co-author(s): L. Grossi)

(CON-10) Quantile methods

M. Bernardi — Bayesian inference for L_p–quantile regression models. (Co-author(s): V. Bignozzi, L. Petrella)

V. Bignozzi — On the L_p-quantiles and the Student t distribution. (Co-author(s): M. Bernardi, L. Petrella)

M. Marino — M-quantile regression for multivariate longitudinal data. (Co-author(s): M. Alfò, M. Ranalli, N. Salvati)

D. Vistocco Comparing Prediction Intervals in Quantile and OLS Regression. (Co-author(s): C. Davino)

(CON-11) Statistical algorithms

N. Loperfido An Algorithm for Finding Projections with Extreme Kurtosis. (Co-author(s): C. Franceschini)

L. Scrucca Poisson change-point models estimated by Genetic Algorithms.

A. Stamm Maximum Likelihood Estimators of Brain White Matter Microstructure. (Co-author(s): O. Commowick, S. Vantini, S. K. Warfield)

(CON-12) Statistics for medicine

G. Barbati Competing risks between mortality and heart failure hospital re-admissions: a community-based investigation from the Trieste area. (Co-author(s): F. Ieva, A. Scagnetto, G. Sinagra, A. Di Lenarda)

C. Brombin Evaluating association between emotion recognition and Heart Rate Variability indices. (Co-author(s): F. Cugnata, R. M. Martoni, M. Ferrario, C. Di Serio)

M. Ferrante Socio-economic deprivation, territorial inequalities and mortality for cardiovascular diseases in Sicily. (Co-author(s): A. Milito, A. Parroco)

M. Giacalone The use of Permutation Tests on Large-Sized Datasets. (Co-author(s): A. Alibrandi, A. Zirilli)

(CON-13) Statistics for the education system

G. Boscaino Further considerations on a new indicator for higher education student performance. (Co-author(s): G. Adelfio, V. Capursi)

C. Masci Analysis of pupils' INVALSI achievements by means of bivariate multilevel models. (Co-author(s): A. Paganoni, F. Ieva, T. Agasisti)

A. Valentini Promoting statistical literacy to university students: a new approach adopted by Istat. (Co-author(s): G. De Candia, M . Carbonara)

(CON-14) Testing procedures

E. Cascini A Reliability Problem: Censored Tests.

G. De Santis Testing the Gamma-Gompertz-Makeham model. (Co-author(s): G. Salinari)

M. M. Pelagatti A nonparametric test of independence.

A. Pini Functional Data Analysis of Tongue Profiles. (Co-author(s): L. Spreafico, S. Vantini, A. Vietti)

A. Vagheggini On the asymptotic power of the statistical test under Response-Adaptive randomization. (Co-author(s): A. Baldi Antognini, M. Zagoraiou)

(CON-15) Time series analysis

C. Cappelli Robust Atheoretical Regression Tree to detect structural breaks in financial time series. (Co-author(s): P. D'Urso, F. Di Iorio)

P. Chirico Prediction intervals for heteroscedastic series by Holt-Winters methods.

M. Costa Inequality decomposition for financial variables evaluation.

G. De Luca Three-stage estimation for a copula-based VAR model. (Co-author(s): G. Rivieccio)

(CON-16) Forecasting methods

M. Andreano Forecasting with Mixed Data Sampling Models (MIDAS) and Google trends data: the case of car sales in Italy. (Co-author(s): R. Benedetti, P. Postiglione)

V. Candila Probability forecasts in the market of tennis betting: the CaSco normalization. (Co-author(s): A. Scognamillo)

S. Vantini Daily Prediction of Demand and Supply Curves. (Co-author(s): A. Canale)

(CON-17) Bayesian statistics (2)

G. Marchese Bayesian hierarchical models for analyzing and forecasting football results. (Co-author(s): P. Brutti, S. Gubbiotti)

L. Paci Bayesian modeling of spatio-temporal point patterns in residential property sales. (Co-author(s): A. E. Gelfand, M. Beamonte, P. Gargallo, M. Salvador)

V. Vitale Non-parametric Bayesian Networks for Managing an Energy Market. (Co-author(s): V. Guizzi, F. Musella, P. Vicard)

(CON-18) Business statistics

E. Bartoloni How do firms perceive their competitiveness? Measurement and determinants.

C. Bocci An evaluation of export promotion programmes with repeated multiple treatments. (Co-author(s): M. Mariani)

A. Righi The inter-enterprise relations in Italy. (Co-author(s): A. Nuccitelli, G. Barbieri)

(CON-19) Clustering and classification

C. Drago Dendrograms Stability Analysis of Sub-periods Time Series Clustering. (Co-author(s): R. Ricciuti)

G. Menardi Stability-based model selection in nonparametric clustering.

T. Padellini Topological signatures for classification. (Co-author(s): P. Brutti)

(CON-20) Demographics and social statistics (2)

M. Antonicelli — Ecolabels: informin or confusing customers? Evidences form the agrifood sector. (Co-author(s): D. Calace, D. Morrone, A. Russo, V. Vastola)

B. Arpino — What makes you feeling old? An analysis of the factors influencing perceptions of ageing. (Co-author(s): V. Bordone, A. Rosina)

G. De Santis — A (partial) solution to the intractability of APC models. (Co-author(s): M. Mucciardi)

G. Gabrielli — Partner reunification of first generation immigrants in Lombardy. (Co-author(s): A. Paterno, L. Terzera)

(CON-21) Statistical inference

E. Kenne Pagui — Median bias reduction of maximum likelihood estimates in binary regression models. (Co-author(s): A. Salvan, N. Sartori)

N. Lunardon — On penalized likelihood and bias reduction. (Co-author(s): G. Adimari)

A. Maruotti — Population size estimation and heterogeneity in capture-recapture count data. (Co-author(s): O. Anan, D. Böhning)

(CON-22) Survey methods

A. Pinto — Italian consumers' food risks perception: an approach based on the correspondence analysis. (Co-author(s): E. Ruli, S. Crovato, L. Ventura, L. Ravarotto)

R. Salvatore — Spatial-temporal multivariate small area estimation. (Co-author(s): F. Cappuccio)

D. Toninelli — Is the Smartphone Participation Affecting the Web Survey Experience?. (Co-author(s): M. Revilla)

POSTER SESSION (POS)

M. Bernardi — Non-conjugate Variational Bayes Approximation. (Co-author(s): E. Ruli)

M. Bernardi — The Multivariate Fuzzy Skew Student–t distribution.

M. Bini — Quality of Educational Services, Institutional Image, Students' Satisfaction and Loyalty in Higher Education. (Co-author(s): L. Masserini, M. Pratesi)

L. Bisaglia — Estimation of INAR(p) models using bootstrap. (Co-author(s): M. Gerolimetto)

D. Bossoli — Effect of internet-based cognitive therapy on children anxiety disorders: results from a marginal logistic quantile regression.

C. Calì Some mathematical properties of the ROC curve. (Co-author(s): M. Longobardi)

M. Cannas Machine learning for the estimation of the propensity score: a simulation study. (Co-author(s): B. Arpino)

M. Cannas An R package for propensity score matching with clustered data. (Co-author(s): B. Arpino, C. Conversano)

A. Coli Mapping local social protection data in Italy. (Co-author(s): B. Pacini, A. Valentini, S. Venturi)

A. Cosma Indirect inference for nonlinear panel data.

I. L. Danesi Cluster Analysis of Transactional Data in the Frequency Domain. (Co-author(s): F. M. Pons, C. Rea)

L. Gabrielli Using purchase market behavior to estimate collective well-being. (Co-author(s): G. Riccardi, L. Pappalardo)

F. Giambona The Bifactor Item Response Theory Model for the analysis of repeated measurements. An application to the measurement of Italian households' well-being. (Co-author(s): M. Porcu, I. Sulis)

A. Lepore A Bayesian short-term strategy for site specific wind potential assessment. (Co-author(s): P. Erto, B. Palumbo, M. Lepore)

A. Magrini Distributed-Lag Structural Equation Modelling: An Application to Impact Assessment of Research Activity on European Agriculture. (Co-author(s): F. Bartolini, A. Coli, B. Pacini)

G. Mastrantonio A multivariate circular-linear hidden Markov model for site-specific assessment of wind predictions by an atmospheric simulation system. (Co-author(s): A. Pollice, F. Fedele)

F. Musella Bayesian networks for supporting the digitization process in Italian schools. (Co-author(s): S. Capogna, M.C. De Angelis)

B. Palumbo Statistical approach in aerospace industry innovation. (Co-author(s): P. Erto, F. Tagliaferri, G. De Chiara, R. Marrone, C. Leone, S. Genna)

B. Palumbo Ship fuel consumption control and engineering approach to fault-detection. (Co-author(s): P. Erto, A. Lepore, L. Vitiello, C. Capezza, D. Bocchetti, A. D'Ambra, B. Antonelli)

A. Petrucci Small area model-based direct estimator for spatial data. (Co-author(s): C. Bocci, E. Rocco)

F. Poggioni Dynamic Quantile Lasso Regression. (Co-author(s): L. Petrella, M. Bernardi)

A. Pramov Estimating dependence within neuropsychological models for designing risk profiles of decision-makers..

A. Pramov Confidence intervals for a partially identified parameter with bounds estimated by the minimum and the maximum of two correlated and normally distributed statistics.

I. Primerano	Semantic Knowledge Detection in Open-ended Questionnaire. (Co-author(s): G. Giordano)
G. Ragozini	A joint approach to the analysis of time-varying affiliation networks. (Co-author(s): D. D'Ambrosio, M. Serino)
M. Restaino	Non-parametric estimators for estimating bivariate survival function under randomly censored and truncated data. (Co-author(s): H. Dai, H. Wang)
G. Riccardi	Bayesian M-quantile regression in Small Area Estimation.
E. Ruli	Optimal B-robust posterior distributions for operational risk. (Co-author(s): I. Danesi, F. Piacenza, L. Ventura)
F. Schirripa Spagnolo	Estimating income of immigrant communities in Italy using small area estimation methods. (Co-author(s): N. Salvati, A. D'Agostino)
M. Soscia	The Switching Skew-GARCH Model. (Co-author(s): M. Bernardi, L. Petrella)
S. Spina	Inference on a non-homogeneous Gompertz process with jumps as model of tumor dynamics. (Co-author(s): V. Giorno, P. Román-Román, F. Torres-Ruiz)
G. Storti	Combining multiple frequencies in multivariate volatility forecasting. (Co-author(s): A. Amendola, V. Candila)
D. Toninelli	An Enhanced Measure of Well-being through Structural Equation Modeling: a Cross-Country Approach. (Co-author(s): M. Cameletti)
A. Vanacore	Statistics for knowledge improvement of an innovative manufacturing process and quality cost management. (Co-author(s): B. Palumbo, F. Del Re, P. Corrado, M. Lanza, G. La Sala, M. Mastrovita)
A. Vanacore	Statistics for Safety and Ergonomics in Design. (Co-author(s): A. Lanzotti, C. Percuoco, A. Capasso, F. Liccardo, B. Vitolo)
L. Zanin	Modelling transition probabilities in a flexible hierarchical logit framework: evidence from the Italian labour market. (Co-author(s): R. Calabrese)

Gender egalitarianism, education and life-long singlehood: A multilevel analysis

Equità di genere, istruzione e life long singlehood.

Un'analisi multilivello.

Daniela Bellani, Gosta Esping-Andersen and Lesia Nedoluzhko

Abstract In this study we use multilevel modeling to examine how gender relations influence life–long singlehood across educational strata in Europe. We focus on women and men aged 40-55 who have never experienced a co-residential partnership. Our results reveal reverse U-shaped relationship between levels of gender equity and singlehood: in countries where traditional gender norms still prevail as well as in countries where gender symmetric norms are broadly diffused throughout the population, we observe low levels of non-partnering. At the same time incidence of singlehood is comparatively high in the countries which undergo transitional stage from traditional to egalitarian gender regime. The highest risks of singlehood correspond to the intermediate levels of gender equity. Our results also show relevant differences in the association of gender egalitarianism on singlehood across levels of education for each gender.

Abstract *In questo studio applichiamo un'analisi multilivello con la finalità di analizzare l'influenza dei ruoli di genere sulla probabilità di essere permanentemente single a seconda del livello di istruzione in Europa. La nostra analisi considera donne e uomini tra i 40 e i 55 anni che non si sono mai sposati e non hanno mai convissuto.I nostri risultati evidenziano un'associazione non lineare e nella fattispecie a u rovesciata tra il livello di equità di genere e il fenomeno d'interesse. Nei Paesi dove prevalgono norme tradizionali relative alla dimensione di genere ma anche dove le stesse sono maggiormente paritarie osserviamo livelli minori di life long singlehood. Parallelamente, vi è una maggiore incidenza di single nei paesi che si collocano in una fase transitoria del passaggio da società tradizionale a società paritaria. Il nostro contributo mostra anche differenze rilevanti nella probabilità di essere single a seconda del livello di istruzione considerato.*

Key words: life long singlehood, educational group, gender equity.

1 Introduction

Single person households are increasingly widespread, primarily driven by youth leaving the parental home, elevated divorce risks, and population ageing (survivors). In this study we hone in on a numerically small segment, namely never-partnered women. Its incidence is about three percent of households across the European Union, ranging from a low of 1.5 percent in Denmark and Sweden to a high of 7 percent in Ireland and Portugal.

Most studies of lifelong singlehood have focused on psychological and health effects (see for example Kohler et. al, 2005). Sociological analyses are few and far between, which is undoubtedly related to its rare occurrence. And some, like Kiernan's (2000; 2002), are predominantly descriptive. Exceptions are the studies of Dykstra and Poortman (2010) and Wiik and Dommermuth (2014), both of which – as we shall also -- focus on socioeconomic differentials of never-partnering (in, respectively, the Netherlands and Norway).

Our analytical framework builds on recent theoretical work which emphasizes the influence of prevailing gender values on marital behavior (Esping-Andersen and Billari, 2015; Goldscheider et.al, 2015). The gist of the argument is that the revolution of women's roles will inaugurate a phase of marriage-cum-partnership decline as long as society fails to adapt. But as normative acceptance of (and behavioral adaptation to) gender egalitarianism takes hold we should expect a return to higher rates of partnering (and also a decline in divorce propensities).

We pay special attention to differences across education levels. The higher educated were initially the vanguard of women's role change and also of the Second Demographic Transition, displaying higher divorce propensities, lower fertility and singlehood (Lesthaeghe, 2010). We would similarly expect that they will spearhead the adoption of gender egalitarian relationships.

Where gender roles remain traditional, higher educated (career) women should be especially disinclined to marry. 1 This, it is argued, is the by-product of their greater earnings capacity and, consequently, less reliance on a male partner's earnings (Oppenheimer, 1997).2 However, we expect that higher educated women will be more inclined to marry in gender egalitarian societies, in part because men will here compete for women's economic resources on the marriage market (Schwartz 2010); and in part because an egalitarian division of gender roles allows women to better combine family and careers. In other words, the effect of women's education on marriage should be less negative when gender roles are more egalitarian (Kalmijn, 2013).

The 'multiple equilibrium' framework espoused by Esping-Andersen (2009) and Esping-Andersen and Billari (2015) hypothesizes a U-shaped relationship between gender roles and marriage (as well as fertility and union stability). It predicts that different stages in the transition from a traditional to a 'gender-symmetric' family model should be associated with different demographic responses. Where the traditional male-breadwinner norm remains dominant, we should expect high rates of partnering (and fertility). In contrast, we should expect a significant decline in the phase of transition – a phase marked by normative uncertainty and little adaptation to women's new roles. But as gender egalitarianism

Daniela Bellani, Universitat Pompeu Fabra, Spain; daniela.bellani@upf.edu
Gosta Esping-Andersen, Universitat Pompeu Fabra, Spain; gosta.esping@upf.edu
Lesia Nedoluzhko, Universitat Pompeu Fabra, Spain; lesia.nedoluzhko @upf.edu

[1] Here and throughout the paper 'marriage' includes also (stable and longer-term) cohabitation.
[2] Note, however, that Oppenheimer's primary expectation is postponed partnering rather than sustained singlehood.

eventually gain dominance, the probability of partnering should rise. Put differently, life-long singlehood rates should be especially high in the phase of transition from one dominant partnership norm to another. In this study we test both linear and curvilinear relationships between gender equity and singlehood.

This study contributes to the now ample research linking demographic behavior to the diffusion of gender egalitarianism and, more narrowly, to the scarce literature on never partnering, which we here approach from a cross-national perspective. The scarcity of data back in time means that it is impossible to analyze change across periods or cohorts. Our analyses, accordingly, are based on cross sectional data. But pronounced differences in gender egalitarianism across the 25 countries we have sampled allow us, indirectly, to capture the link between levels of gender egalitarianism and singlehood.

1.1 Hypotheses

We focus on women and men aged 40-55 who have never experienced a longer-term heterosexual co-residential partnership.[1] As noted, our main concern is with the influence of gender egalitarianism on singlehood across educational strata.

The failure to partner can, as discussed earlier, be related to rival factors. At the individual level there are a host of idiosyncratic reasons why any given woman prefers (or at least ends up in) singlehood. As Buss et.al (2001) show, preferences regarding mating have changed substantially over the past half century, among both men and women. Financial prospects, attractiveness, and life-style choices have become much more decisive (see also Pampel, 1983). Additionally, women's enhanced economic independence allows any given individual much more freedom to choose. And, as noted, at the societal level the growing gender gap in educational attainment, especially at the tertiary level, is likely to result in a shortage of marriageable males. In any typical OECD country, women now outnumber men in university level education by a substantial margin (Esteve et.al, 2012). On average, the female: male ratio hovers between 1.2-1.3 (OECD, 2014: Table C3.1).[2] This suggests that there are roughly 20-30 percent more women than men with tertiary level education. [3]

The preceding discussion suggests the following four hypotheses:

Hypothesis 1. In line with previous studies, we expect to find opposite education effects for men and women: lifelong singlehood is most likely among low educated males and highly educated females.

Hypothesis 2. Lifelong singlehood levels depend on the diffusion of gender egalitarian norms. We expect low levels where either traditional or gender egalitarian norms are dominant.

Hypothesis 3. The diffusion of gender egalitarianism is likely to be asymmetric, with women in the vanguard and men trailing behind. We hypothesize that the greater is this gender gap, the higher are the levels of lifelong singlehood among women – especially the highly educated.

---

[1] Wiik and Dommermuth (2014) adopted the same age criterion.

[2] Norway and Sweden boast an exceptionally high ratio (1.5). In contrast, Belgium and Germany present a gender-balanced profile.

[3] Addressing the much larger population of persons living alone, Klinenberg (2012) cites additional factors that promote 'going solo': more wealth gives us freedom to choose, and the internet allows us to be connected.

Hypothesis 4. We expect that the diffusion of gender egalitarianism is mainly of importance for the partnering choices of highly educated women.

2 Empirical analysis

Our analyses exploit the European Social Survey (ESS) data for 2002, 2004, 2006, 2008, 2010 and 2012 waves, and the European Values Survey (EVS) for 2008-9. Since the sampling frame and the variables of interest are similar, we pool the two datasets. Doing so, we obtain larger national samples which facilitate making comparisons between sub-groups broken down by individual characteristics such as education, gender, and religiosity.

We compare individuals who are or have been in a co-residential partnership (marriage and/or cohabitation) with those who have never been partnered (defined as lifelong single). To test our hypotheses we split the sample by gender and estimate with multilevel models. The data from both surveys have a hierarchical, multi-level structure. We consider two levels, where individuals are nested within country-year combinations, i.e. level-two units. We restrict our analyses to women and men aged 40-55 between 2002 and 2014. Since the period spans more than one decade, we split it into two periods: 2002-2008 and 2010-2014, respectively. Greece, Latvia, Lithuania and Romania are not included for both periods due to missing information on key variables. In total, we obtain 54 country-period combinations In our analyses we exclude countries not belonging to the European Union (except for Switzerland, Iceland, Norway and Ukraine)

Dependent variable: life-long singlehood.

As discussed earlier, our dependent variable measures individuals who by age 40-55 have never been married and or have lived in a co-residential union for more than 6 months. Note however that we are forced to adopt a three-month criterion for the ESS Round 3 (2006) data. The age of 40 was chosen as the minimum threshold to ensure a high likelihood that they will remain single for the rest of their lives (Dykstra et al 2010). To obtain a more homogeneous group in terms of contextual characteristics, we exclude persons over the age of 55.

Lifelong singlehood is identified by a battery of questions, such as "Could I ask about your current legal marital status?", "Have you ever lived with a partner without being married?" "Are or have you ever been married?" and "Have you ever been divorced or had a civil union dissolved?" Our dependent variable assumes the value of zero if the interviewed has been (or is) in a partnership, while it assumes the value of one for those never partnered. In total, the pooled dataset, (EVS 2008-9 and ESS 2002-2014) contains 44871 women and 38688 men. The mean level of life-long singlehood is 4.2% (n=1873) for women; 7.3% (n=2815) for men.[1]

Explanatory variables.

Our main explanatory variable is the respondent's level of education. For reasons of parsimony, we distinguish three categories, using the International Standard Classification of Education (ISCED). The first level represents those with no more than lower secondary schooling (ISCED 0-2); the second includes those with upper secondary level attainment (ISCED 3-4); and the third (ISCED 5-6) includes those with tertiary level education. Descriptive statistics for individual level characteristics show that, on average, 21.2% of men

[1] We drop from our sample France in 2002 and 2004 (ESS), Finland and Ireland in 2010 (ESS) and Czech Republic in 2012 (ESS) because missing values exceed 60% of the sample.

and 23.3% of women fall in the first category; 54% of men and 50% of women the second; and 24.8% of men and 26.9% of women the third.

Macro-variables

Since we focus on between-country variability, we also include indicators related to attitudinal and structural differences at the level of nations, in particular those that help capture gender norms (Arpino et al, 2015; Esping-Andersen and Billari, 2015).

Our measure of gender equality derives from a variable with which respondents are asked to agree or disagree: "When jobs are scarce, men should have more right to a job than women". We recode this variable into a binary response, the category "agree" or "neither" takes value 0 and the category "disagree" takes value 1. The respondents who disagree are classified as having gender-egalitarian views. [1]

Since this question is included in both the European Values Study (EVS) and the World Values Study (WVS) we pooled the two datasets. We then selected women and men aged 18-55 for the two periods, 1989-1999 and 2000-2010. For each of these time intervals, we measure the percent of gender equitable respondents by country. As in Arpino et al (2015), we interpret this indicator as the measure of gender equity characterizing the decade considered. [2]

To test for a curvilinear relationship, we also include a quadratic function of the gender egalitarianism measure. Since the inclusion of this variable improves the fit of the model significantly, we shall not report results for the linear specification.

Following (Arpino et al 2013), we also examine the effects of the gender equality gap, a variable that measures the difference between women's and men's level of gender egalitarianism: the higher the value, the greater is the distance that separates the two genders. A large gap represents a situation in which gender equality is supported more by women than men. A country which boasts small gender gaps together with overall high values of gender equality represents, in our framework, a society in which egalitarianism has become normatively dominant. Table 3 presents a description of the two variables.

Here we observe substantial variation across nations (the data here is averaged over the two periods considered). About 90 percent of Nordic respondents support gender equality - with the exception of the Finnish (about 80%). The Nordic countries, and Denmark *par excellence*, appear in this respect to have moved decisively towards a gender egalitarian equilibrium. Here, gender egalitarianism is close to universal (95%), and the gender gap is almost zero. Coincidentally, in Denmark (as in Sweden), the incidence of lifelong singlehood (around 1.5 percent) is comparatively low.

This contrasts sharply with Eastern European countries, such as Croatia, Bulgaria and Ukraine, which combine a large gender gap with modest overall levels of gender equality (around 50%). And here we find lifelong singlehood rates that are more than three times as high as in Denmark (in Croatia, to exemplify, the female rate is about 6%). The Mediterranean countries are located somewhere between these extremes with a medium-low rate of gender egalitarianism accompanied by medium levels of the gender gap. And the Continental European countries, such as France and Netherlands (and also Great Britain), display a medium level of gender egalitarianism with a modest gender gap

A multilevel model with random intercepts

---

[1] In a sense, this variable captures also equity issues, i.e. what is considered fair. Since equitable treatment by gender is a core precondition for gender egalitarianism more generally, we use this variable to signal the degree to which gender egalitarian norms prevail in any given society.

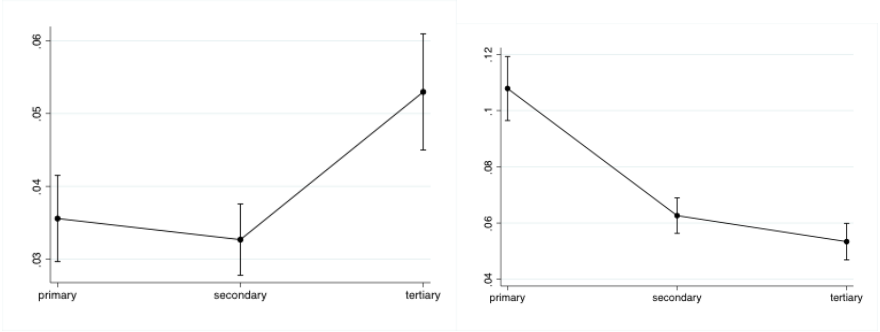
[2] According to Arpino et al (2015) this indicator, compared to alternative measures in the WVS-EVS, is the single most valid one in terms of capturing gender equity.

We use multilevel models to assess the role of education on the likelihood of remaining single, and to get a better grip on the complex causal process underlying marriage market choices at both the individual and societal level. Since individuals are clustered within countries, this can lead to an underestimation of the standard errors (Snijders and Bosker, 1999). We distinguish two levels of analysis, individuals at level 1 and country-periods at level 2. Estimation is based on two-level logistic regression models (see, eg, Rabe-Hesketh and Skrondal, 2012).[1] We present coefficients with their standard errors and level 1 and 2 unexplained variance. We use maximum-likelihood estimation with adaptive quadrature.
In order to test our hypotheses, we report results separately for men and women since we expect important gender differences with respect to education, and also in terms of macro level effects.

3 Empirical results.

We estimate the predicted probability of being life long singlehood by education level. Beginning with women (Panel a), the predicted probability of being lifelong single for women with tertiary education is the highest - about 5.5%. The predicted probability for the other educational groups is significantly lower (about 3.5% for those with medium or low education).

Figure 1: Predictive Probabilities of lifelong singlehood by education with 95% CIs, women (Panel a) and men (Panel b)



Turning now to men (Panel b), we observe exactly the opposite. The highest probability of lifelong singlehood is found for those with low levels of education (about 11.5%), while high and medium educated men have a significantly smaller propensity (between 5% and 6%). Our first hypothesis is therefore supported by our results.

[1] Due to the nature of the data, we did additional robustness checks using three levels, individuals, country and country-period. Results are similar to the ones obtained with two levels (see Appendix A4-A7).

To test hypotheses 2 and 3, i.e. that lifelong singlehood rates vary by the degree of diffusion of gender egalitarian norms overall, as well as by the extent to which there exist gender equality gaps, we estimate four multilevel models.
To facilitate the interpretation of these results, Figure 2 shows the predicted values of lifelong singlehood corresponding to different levels gender equality. In the left panel we take estimations from Table 4 Model 4a, and in the right panel we use estimations from Table 5 Model 4b, where gender equality and its squared term are included as covariates. This allows us to predict the probability of lifelong singlehood corresponding to different levels of gender Equality, ranging from about 40% to almost 100%. The u-shaped impact of gender equality is quite manifest for both genders.

Figure 2: Predicted probabilities of lifelong singlehood by levels of gender egalitarianism (95% confidence level intervals) with 95% CIs, women (Panel a) and men (Panel b)

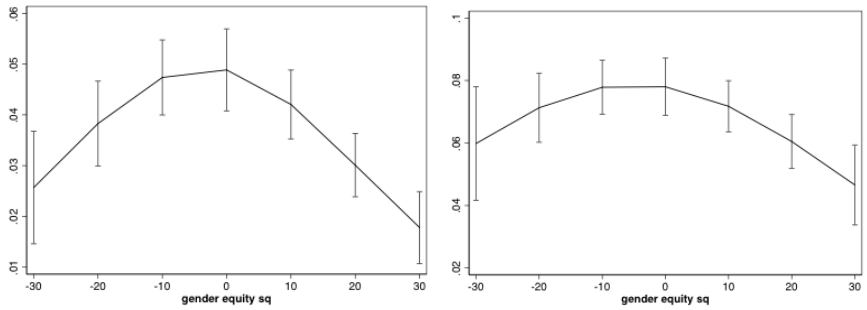
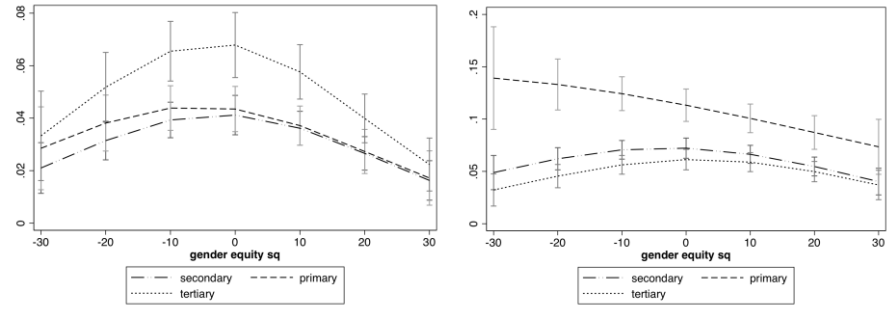


Figure 3 plots the predicted probability of remaining un-partnered by educational level across levels of gender equality. We note that the likelihood of singlehood is firstly positively and then negatively related to all levels of education for women. Interestingly, focusing on medium levels of gender equality, we note a significant difference between, on one hand, the low and medium educated and, on the other hand, the highly educated. When gender equality assumes values close to the average, tertiary educated women experience a higher likelihood of remaining lifelong single (the predicted probability is about 3 percentage points higher) compared to the rest. In this case, the effect of gender equality is consistent with the predictions of Hypothesis 4.

Figure 3. Predicted probabilities of lifelong singlehood by education and levels of gender egalitarianism with 95% CIs, women (Panel a) and men (Panel b).



Within our framework, this inverted U-curve can be interpreted as follows: the incidence of singlehood should rise, especially for higher educated women, in the early stages of women's role change, i.e. before gender egalitarian norms have taken hold. But once they achieve dominant status, the 'marriage market' for highly educated women improves and, as a consequence, the probability of finding an acceptable match is higher.

4 Conclusions

Lifelong singlehood occupies a marginal place, both in the overall household mix, and in terms of scholarly attention. At the level of individuals, to opt out of partnerships is no doubt the result of a host of idiosyncratic factors that are very difficult to nail down with the kind of data available to us. Our starting point, however, is the surprising degree of variation in its magnitude across societies. How does one explain why it hardly exceeds 1-2 percent in Scandinavia and 7 percent in Ireland?

Our main thesis derives from recent theoretical contributions to our understanding of the demographic consequences of the ongoing revolution of women's roles (Author et al, 2015; Goldscheider et.al, 2015). In a nutshell, the thesis predicts that lifelong singlehood will remain rare as long as traditional gender norms prevail. As women's role change accelerates, but gender norms fail to adapt, this is when we should expect an overall decline in partnering (and also heightened couple instability). Dynamically speaking, we should expect a return to higher partnering levels and a decline in lifelong singlehood once gender egalitarian norms (and practices) have diffused widely within society.

References

1. Arpino, B., Author, G., Pessin, L.: How do changes in gender role attitudes towards female employment influence fertility? A macro-level analysis. European Sociological Review. 1–13 (2015)

2. Brand, J. E., Davis, D.: The impact of college education on fertility: Evidence for heterogeneous effects. Demography. {48}, 863–887 (2011)
3. Buss,D, Shackelford, T, Kirkpatrick, L, Larsen, R: A half century of mate preferences. The cultural evolution of values. Journal of Marriage and Family. {63}, 491-503 (2001)
4. Cotter, D., Hermesen, J., Vanneman, R: The end of the gender revolution? Gender role attitudes from 1977 to 2008. American Journal of Sociology. {117}, 259-289 (2011)
5. Dykstra, P.A: Loneliness among the never and formerly married: The importance of supportive friendships and a desire for independence. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences {50 (5)}, 321-329 (1995)
6. Dykstra, P.A., Poortman, A. R.: Economic resources and remaining single: Trends over time. European Sociological Review (2009) doi:10.1093/esr/jcp021
7. Esping-Andersen, G.: Incomplete revolution: Adapting welfare states to women's new roles. Polity Press (2009)
8. Esping- Andersen, G., Billari, F. C.: Re- theorizing Family Demographics. Population and Development Review, {41(1)}, 1-31 (2015)
9. Esteve, A., Garcia-Roman, J., Permanyer, I.: The gender-gap reversal in education and its effect on union formation: the end of hypergamy? Population and Development Review. 38: 535-46 (2012)
10. Goldin, C.: The long road to the fast track: Career and family. Annals of the American Academy of Political and Social Science. {596}, 20 – 35. (2004)
11. Goldscheider, F., Bernhardt, E., Lappegård, T.: The gender revolution. A framework for understanding changing family and demographic behavior. Population and Development Review {41(2)}, 207–239 (2015)
12. Heard, G.: Socioeconomic marriage differentials in Australia and New Zealand. Population and Development Review. {37}, 125–160 (2011)
13. Kalmijn, M: The influence of men's income and employment on marriage and cohabitation: Testing Oppenheimer's theory in Europe. European Journal of Population, 27, 269–293 (2011)
14. Kalmijn, M.: The educational gradient in marriage: A comparison of 25 European countries. Demography {50}, 1499–1520 (2013)
15. Kiernan, K.: The state of European Unions: an analysis of partnership formation and dissolution. In M. Macura and G. C. N. Beets (eds.) Dynamics of Fertility and Partnership in Europe. Volume 1. Proceedings of the Family and Fertility Surveys Flagship Conference, Brussels 2000. New York and Geneva: United Nations, {1}, 57-76 (2002)
16. Kiernan, K.: Unmarried cohabitation and parenthood in Britain and Europe. Law and Policy {26(1)}, 33-55 (2004)
17. Lesthaeghe, R.: The unfolding story of the second demographic transition. Population and Development Review. {36(2)}, 211-251 (2010)
18. Lin, I-F., Brown, S. L. Unmarried boomers confront old age: A national portrait. The Gerontologist. {52 (2)}, 153–165 (2012)
19. Musick, K., Jennie E. Brand, J.E., Davis, D.: Variation in the relationship between education and marriage: Marriage market mismatch? Journal of Marriage and Family. {74}, 53 – 69 (2012)
20. Klinenberg, E Going Solo. London: Penguin Books (2012)
21. Kohler, H.P, Behrman, J., Skythe, A.: Partner + children = happiness? The effects of partnership nd fertility on well-being. Population and Development Review. {31}, 407-45 (2005)
22. OECD Education at a Glance. Paris: OECD (2014)
Oppenheimer, V. K.: A theory of marriage timing. American Journal of Sociology. {94}, 563 – 591 (1988)
23. Oppenheimer, V. K.: Women's employment and the gain to marriage: The specialization and trading model of marriage. Annual Review of Sociology. {23}, 431–453 (1997)
24. Oppenheimer, V. K., Lew V.: American marriage formation in the eighties: how important was women's economic independence? in K. Oppenheim Mason and A. Jensen (eds.), Gender and Family Change in Industrialized Countries. Oxford: Clarendon, pp. 105_138 (1995)
25. Pampel, F.: Changes in the propensity to live alone'. Demography. {20}, 433-47 (1983)
26. Thornton, A., Axinn, W. G., Teachman, J. D.: The influence of school enrollment and accumulation on cohabitation and marriage in early adulthood. American Sociological Review. {60}, 762 – 774 (1995)

27. Torr, B.: The changing relationship between education and marriage in the United States: 1940–2000. Journal of Family History. {36}, 483–503 (2011)
28. Schwartz, C. R.: Earnings inequality and the changing association between spouses' earnings. American Journal of Sociology. {115(5) }, 1524-1557 (2010)
29. Sweeney, M. M.: Two decades of family change: The shifting economic foundations of marriage. American Sociological Review. {67},132-147 (2002)
30. United Nations Economic Commission for Europe and United Nations Population Fund: Dynamics of fertility and partnership in Europe: Insights and lessons from comparative research. UN: Geneva (2002)
31. Wiik, K. A., Dommermuth, L.: Who remains unpartnered by mid-life in Norway? Differentials by gender and education. Journal of Comparative Family Studies. {3}, 405-424 (2014)