

Institution: Birkbeck, University of London
Unit of Assessment: 16 - Economics and Econometrics
<p>1. Unit context and structure, research and impact strategy</p> <p>1.1 Aims of the unit</p> <p>The research submitted under UoA 16 has been carried out in the Department of Economics, Mathematics and Statistics (EMS). EMS was formed in 2000 through the merger of the Department of Economics and the Department of Mathematics and Statistics. EMS is one of four Departments in the School of Business, Economics and Informatics (BEI), which is one of five Schools at Birkbeck. EMS includes 26.15 FTE academics (15.15 FTE in Economics and Econometrics, 7 FTE in Mathematics and 4 FTE in Statistics).</p> <p>Although this combination of disciplines is unusual in the UK, it fosters significant synergies across economics, finance, mathematics and statistics, which are evident in overlapping research, seminar series and teaching, all of which benefit from the informal engagement that follows from physical co-location.</p> <p>Since the 2014 REF census, our research focus has led to the publication of more than <u>450</u> articles, book chapters and working papers, a number of external and internal grants, 37 PhD awards and prestigious awards to our senior and junior academic staff: Hart was the first woman to be appointed as the UK's prestigious Gresham Professor of Geometry in its history dating back to 1596; Gomes received the Austin Robinson Memorial Prize for a paper published in the <i>Economic Journal</i>; Pokrovskiy was jointly awarded the European Prize in Combinatorics, recognising contributions in Combinatorics, Discrete Mathematics and their Applications by European researchers aged 35 and under.</p> <p>At REF 2014, our research was loosely structured into macroeconomics, microeconomics, econometrics, finance, statistics, and mathematics. Our stated objectives were promotion of excellence in our chosen areas; an emphasis on the integration of theoretical and empirical analysis to produce applicable results of relevance to practitioners and policy makers; fostering the development of mathematics and statistics; exploiting the synergies between economics, mathematics and statistics; and exploring the development of more research linkages (within Birkbeck and elsewhere) with political science, sociology and psychology. An additional focus was the further enhancement of existing research strengths in macroeconomics (for instance by establishing a research centre, Birkbeck Centre for Applied Macroeconomics (BCAM)).</p> <p>Since 2014 we have made 11 new appointments, 10 lecturers (all early career researchers), and one Reader. This focus on recruitment of early career researchers was a strategic choice: a central, and very successful, element of our strategy, described below, has been supporting the development of these new colleagues who have made a major contribution to the research environment of the Department.</p> <p>Over the next five years, we will focus on: recruiting promising early-career researchers to further consolidate our existing strengths and foster the development of research areas (such as data-driven analysis of health care provision); exploring further collaborations with researchers in social sciences and computer science; and training new researchers through our rigorous doctoral</p>

programmes.

1.2 How research is organised within the unit

In 2015, EMS reviewed and refined its research strategy to increase focus and improve monitoring of progress. The Department Research Committee was restructured and its responsibility for monitoring and guiding research expanded. Four relatively formal research groups were established, each with a lead researcher. Within the groups, there are more specialised thematic clusters which, like our two Research Centres, also provide links between groups. Each researcher is in at least one group based on their disciplinary specialisation and preferences. The groups are porous enough to exploit interdisciplinary synergies while focused enough to maintain disciplinary coherence.

The research groups and the embedded clusters are:

Econometrics and Statistical Sciences: Ball, Beckert, Brooms, Chandna, Kaliski, Papageorgiou, Psaradakis (lead), Pymar, Smith

- *Quantitative health:* This cluster has emerged since the last REF and is focused on applied econometric analysis of health with related theoretical investigations.

Macroeconomics: Aksoy (lead), Geman, Gomes, Sibert, Wright, Zoega

- *Demographic change:* This cluster investigates short and term implications of aging populations on macroeconomic outcomes.
- *Public economics:* This cluster focuses on defence economics, public sector employment, debt and deficits.

Microeconomics: Daripa, Kapur (lead), Schroeder, Sciubba, Versteeg, Yu

- *Decision-making under imperfect information:* Research in this cluster focuses on theoretical and empirical analyses of decision-making under imperfect information.

Mathematics: Baxter, Fairbairn, Hart, Hubbert, Noble, Paterson (lead), Peri

- *Approximation theory:* This cluster is a group of applied mathematicians within the mathematics research group developing tools in approximation theory which can be applied in a variety of practical ways, including pricing problems in finance.

Combinatorics: This research cluster combines expertise in graph theory, combinatorial group theory, combinatorial cryptography and applications.

The creation of these groups was a deliberate and systematic process. For instance, the previous informal collection of researchers in finance found their research was growing closer to the new formal groups: so Baxter, Hubbert and Peri moved to the Mathematics group, while Schroeder and Versteeg moved to Microeconomics.

The research group lead advises other members of the group, supports other informal mentoring

arrangements, and conducts annual reviews. Groups also organise events such as the Microeconomics group's Economic Theory workshops, where internal and external researchers present and the recently-introduced Research Meet-ups in which members of both the Mathematics and the Econometrics and Statistical Sciences groups discuss their research and share research-related news and opportunities.

Research group leads report termly to the Department Research Committee. The Committee is chaired by the UoA lead for Economics and Econometrics (Aksoy) and includes the leaders of the department's research groups and research centres, the PhD programme directors, and the School Assistant Dean for Research (Psaradakis).

The Department Research Committee reports to the BEI School Research Committee, which is, in turn, guided by the College Research Committee. The School Research Committee develops and shares best practice across departments; monitors research student recruitment and progression; facilitates applications and awards for external research grants; and works to enhance the School's research environment. The School also provides research, impact and conference grants. Department research activity is further supported by three senior School administrative staff: the Research Development Officer, the Impact Officer and the Finance Officer, who manage the School's research processes, research grant portfolio and research-related publicity. The College Research Office also supports academic staff in preparing and submitting external grant applications and in communicating with funders. The School's Ethics Committee oversees research ethics and integrity.

The Birkbeck Centre for Applied Macroeconomics, led by Aksoy and Gomes, was established in 2014 to facilitate research in applied macroeconomics and to enhance existing strengths in macroeconomics and econometrics. It attracts national and international academic visitors, organises an annual conference and regular macroeconomic policy talks. It links Birkbeck macroeconomists to current and former PhD students; other academic macroeconomists; and policymakers. Its working paper series publishes work by external affiliates as well as Birkbeck staff, contributing to department's global visibility. It supports early-career researchers through, for instance, poster sessions for PhD students at its conference. BCAM activities are financed by the School and the Money Macro & Finance Society.

The Commodities Finance Centre, led by Geman, provides a platform for our researchers working in subjects ranging from crude oil to natural gas, from renewable energies to transportation and organises workshops.

The department has two regular seminar series for external speakers, one in economics and finance, the other in mathematics and statistics, though there is cross attendance. There are also very popular weekly internal workshops where we present our research to each other. Online seminars during the lockdown have been well attended. Termly, daylong PhD "Jamborees" allow our research students to present their work.

There is an annual Tress Memorial Lecture (the late Ronald Tress, Master of Birkbeck 1968-1977 established the economics department). Recent speakers have included Silvana Tenreyro (External Member of the MPC) on 'Understanding Inflation: Expectations and Reality', and Sir Adrian Smith on 'The Challenge of Big Data'.

Our research networks, through collaborating and co-authoring, cover academic institutions (e.g.

Carlos III Madrid; Collegio Carlo Alberto; Ottawa; the Technion, Haifa; NYU, UC Berkeley, USC among others), policy institutions, think tanks and charities. The value of these networks is especially evident in the professional destinations of our graduating PhD students, who typically go to research-oriented policy institutions worldwide so their doctoral research has immediate impact on their practice. We collaborate across London with UCL, IFS, Royal Holloway and City University in training doctoral students. Since 2007 we have been part of the 'London Graduate Programme in Mathematical Finance' a joint initiative with LSE, King's and Imperial which provides PhD level training in mathematical finance.

Since 2018-19, an annual research newsletter is circulated in the department. It lists research achievements, publications, grants, PhD completions and events to facilitate research communication.

1.3 Research objectives

Our research mission is aligned with four key values of the School of BEI which are (i) to conduct high quality research disseminated in high quality academic journals and conferences; (ii) to ensure that our research is relevant, socially-engaged and impactful for the research community and on the practices of policymakers, government, business, industry and voluntary sector; (iii) to achieve a synergy between research and teaching; and (iv) to communicate the outcomes of our research to the public at large and to academic and user communities.

In line with these, the department's current research objectives are:

1. to continue the promotion of frontier, impactful and socially beneficial research in our chosen fields and to identify/ encourage new areas of research;
2. to consolidate our chosen and emerging areas (such as Quantitative Health) of research excellence through staff hires focusing particularly on recruiting outstanding early-career researchers; to support necessary infrastructure (research time, computing facilities and financial support); to provide academic leadership through mentoring and research career development;
3. to nurture outstanding new talent through our highly competitive graduate training programmes.

Following the previous REF, a departmental research review in 2015 led to consolidation of our research into four formal research groupings that support the research clusters described in Section 1.2.

Macroeconomics: This is a traditional area of strength in Birkbeck. The group has included Aksoy, Driffill, Gomes, Morrow, Petrella, Povala, Sibert, Sola, Wright, Zoega and published on policy-relevant issues including DSGE models and macro-econometric modelling in the short run (Wright), firm heterogeneity and imperfect competition (Morrow), aging and consumption over the lifecycle (Aksoy), credit ratings (Gomes), political economy and economic growth (Zoega), cryptocurrencies, commodities and machine learning (Geman). The *Demographics and Macroeconomy cluster* (Aksoy, Smith and Zoega) discussed in an impact case study, studies the impact of global fertility and mortality rate declines on output, investment and immigration. The *Public Economics* cluster studies public sector wage and employment policies and their interactions with private sector labour market, public investment and technological change (Gomes); defence economics and aspects of fiscal and monetary policy (Smith).

Microeconomics: This group works on the theoretical implications of ambiguity aversion (Daripa,

Sciubba, Schroeder); evidence of its existence in survey data (Schroeder) and in experimental contexts (Sciubba, Schroeder); auction design in the presence of shills and snipes (Daripa); the perverse impact of information disclosure in environmental regulation (Kapur); the timing and pricing of dividends and the value premium (Schroeder; an impact case study); financial contagion in the Eurozone (Versteeg); how mechanism design can optimise collaboration networks (Daripa and Kapur). With the recent appointment of a political economist, we have extended our research themes to include political economy of propaganda and polarisation. The group supports the *Decision-making under Imperfect Information* cluster, examining the impact of ambiguity aversion in choice, how information flows can have perverse effects, and the use of mechanism design to achieve efficient outcomes in environments with limited information.

Econometrics and Statistical Sciences: The group works on probability theory and stochastic processes (Brooms, Pymar), linear and nonlinear time series analysis and resampling methods (Chandna, Psaradakis, and Wright), Bayesian statistical analysis (Papageorgiou, Smith), empirical macroeconometrics (Psaradakis, Smith), empirical microeconometrics, competition analysis (Beckert). The *Quantitative Health* cluster, an impact case study, has emerged since 2014. Topics covered include short and long term economic costs of pollution (Ball), the capability approach to disability (Smith), NHS and patient sorting (Beckert) within the context of regression-discontinuity designs, social security and retirement (Beckert, Kaliski), causes of socioeconomic disparities in health and how individuals respond to the health risks they face (Kaliski). Radice had a paper on HIV prevalence, published in the Journal of the American Statistical Association. Given the size and scope of the cluster and on-going seminar collaborations with Imperial College, we have started the process of establishing a new College Research Centre dedicated to this area.

Mathematics: Our aim, expressed in our REF2014 environment statement, to foster the further development of mathematics and statistics led to successful hires in mathematics to develop clusters based around existing key research strengths bringing expertise in graph theory to the *Combinatorics* research cluster emerging from the work of Fairbairn (combinatorics relating to group theory), Hart (product-free sets and "solving equations in groups") and Paterson (combinatorial cryptography). The *Approximation theory* cluster which has applications in financial mathematics and risk measure theory. Since 2014, mathematics at Birkbeck has re-established its presence within the UK mathematics community; for example, hosting the London Algebra Colloquium for the first time in many decades.

Following our 2015 Research Review, we have strategically taken advantage of internal College funding for research, which, whilst still highly competitive, provides feedback on every stage of the application process, enabling our early career researchers to gain the skills and track record needed to apply for external grants. For example, Birkbeck has a Wellcome Trust Institutional Strategic Support Fund, ISSF, to support research in Medicine and health. ISSF grants are awarded to institutions in receipt of the largest amount of Trust money. Beckert received a grant from this fund for a health economics project described in his impact case study; Ball for a project on exposures to atmospheric pollution and mental health; and Kaliski on the impact of political geography on health outcomes in South Africa. Similarly, Daripa and Kapur secured funding from the College Newton Fund to explore the adoption of digital money in the wake of a demonetisation episode in India.

Over the next five years we will look to develop interdisciplinary projects with other Birkbeck departments, such as Computer Science, where there is potential both for bringing complementary skills to areas of common interest, and for learning from their experience of delivering large externally funded research projects.

1.4 Impact strategy

The Department takes a proactive approach to generating economic and societal impacts by embedding the impact agenda in our recruitment strategy and strategic directions for individual research clusters, and by monitoring emerging impacts as a standing item in our Department Research Committee, research group and research centre meetings. Our three impact case studies provide evidence of the success of this approach. The research by Aksoy and Smith on demographic structure and macroeconomic trends had significant influence on fiscal, monetary, immigration policy discussions at high level policy institutions and was used in the development of pension models at the European Central Bank. Beckert's research on competition and patient choice has changed health policy and directly influenced all hospital/NHS trust merger decisions in the census period. Schroeder's research on equity duration has affected financial investment decisions made by major international companies. Examples of other impacts and impact pathways are provided in section 4.

Support for impact is provided by the School Impact Officer, who works with academic staff to identify opportunities for knowledge exchange, to develop REF impact case studies, and to facilitate integration of EMS and College Impact Strategies. Staff members applying for external research grants consult with the Impact Officer to ensure that knowledge exchange and impact considerations are built into research from the outset. We actively seek out external participation and funding from industry and policymaker partners to enable mutual benefits from our research. Likewise, an alumni donation allowed us to appoint the Sundstrom Reader in Mathematics (Noble). During May-June 2017, Aksoy visited the Bank of Spain as a resident fellow. Resulting research forms one of our impact case studies. Since 2001, Wright has provided technical advice on the role of cost of capital estimates in price regulation. He was lead author of a 2018 report which set out a framework for the careful use of current and historic market return data in setting allowed returns that has been heavily cited in debates between regulators, regulated companies and the CMA, and has had a clear impact on recent decisions by UK regulators to reduce allowed returns. .

We are committed to open science ethos (See Section 1.6 below). We aim to ensure that all our research outputs and events (publications, preprints, and workshops) are accessible as widely as possible to all potential industry and policy stakeholders free of charge, as well as to researchers, especially in the developing world. We utilise departmental and College websites and online event outlets (Eventbrite, Inomics) to communicate research events. BCAM conference videos are available online. We record videos on our research with the BEI Film Unit's assistance, participate in the College research initiative Birkbeck Inspires, and make recordings available on YouTube and our websites (e.g. Aksoy on demographics, Ball on atmospheric pollution, Beckert industrial organisation, Gomes on four-day working week, Hart on graph theory, Smith on UK debt). We seek funding for research events to facilitate communication and impact. Our two recent BCAM conferences are funded by School impact grants (£5k each) and the Money Macro & Finance Society (MMF), allowing free access. Our collaboration with MMF leads to dissemination of events news via their databases that include a substantial number of policy and industry stakeholders.

We are proactively developing our skills to secure knowledge exchange grants as a mechanism to support our impact strategy further down the line. For example, Geman received a €100K EU grant as a Partner in the Erasmus Knowledge Alliance grant on 'Green Energy Finance', a project which involves 14 partners from Europe and Brazil, 7 universities, and 7 companies in the energy sector to create a two-year MSc programme.

1.5 Interdisciplinarity

Interdisciplinarity is built into our departmental structure, our shared teaching and our research ethos. Links naturally arise between economists and mathematicians in mathematical finance and between econometricians and statisticians in shared techniques. This unity is reflected in that fact that, as in previous submissions, all staff are being submitted to UoA 16 as a genuinely shared research environment.

In REF2014 we declared our strategy to develop research linkages with political science, sociology and psychology. Among other successes was the establishment of the Centre for Political Economy and Institutional Studies (CPEIS), a Birkbeck Research Centre that brings together faculty and students from the departments of Management, EMS, Politics and Law. Kapur and Smith lead on this from EMS.

Members of staff, including Paterson (cryptography), Geman (crypto currencies, commodities and machine learning), and Smith (big data in forecasting), are active in the Birkbeck Institute for Data Analytics (BIDA), an interdisciplinary grouping centred in the Department of Computer Science but with membership drawn from across the College.

EMS staff co-supervise interdisciplinary PhD students. Papageorgiou co-supervises one funded by a Bloomsbury Studentship with Professor of Musicology Richard Widdess (SOAS), and Beckert one with a colleague at the London School of Hygiene and Tropical Medicine on food prices, consumer behaviour and public health.

1.6 Open research

In addition to the information provided in Section 1.4, EMS researchers are keen to disseminate their research as widely as possible, and this includes a commitment to open access. All research outputs are made available online on BIROn, Birkbeck's publications repository. In addition, our economics research in its pre-publication form is available online through our departmental ([BWPEF](#)) and BCAM ([BCAMWP](#)) working paper series. Both series are linked to global RePEc archives and freely available to all researchers. Likewise *The [Birkbeck Mathematical Sciences Preprint Series](#)* consists of papers written by researchers in the mathematical sciences, and these researchers also post versions of their papers on global repositories such as ArXiv.

1.7 Ethics and Integrity

Birkbeck has implemented the concordat for research integrity, and all members of the department are expected to uphold the highest standards of rigour and integrity in all aspects of research and ensure that their research is conducted according to appropriate ethical, legal and professional frameworks, obligations and standards. There is appropriate training and procedures to maintain those standards.

The Department Research Ethics Officer (Smith) is responsible for making staff and students aware of the ethical requirements of their research. Any research involving human subjects, such as surveys or experiments, requires ethical approval. This includes undergraduate, masters and PhD dissertations. Routine cases are approved at the Department level; more sensitive cases are decided at the School or College level. Often the approval process leads to improvements in aspects such as informed consent and data management. Smith also advises on cases where

student research involves the use of confidential work-related data. The Department Research Ethics Officer reports to the School Ethics Committee, which oversees the ethical standards across the School and runs frequent workshops on research ethics to ensure that staff and students are aware of the College's principles and procedures on both research ethics and research integrity. Issues of research integrity play a central role in the mentoring of early career researchers.

2. People

2.1 Staffing strategy

Our staffing strategy focuses on hiring excellent junior researchers whose areas of expertise complement and extend our existing or emerging research clusters (for example, quantitative health economics), whose research is likely to generate impact, and who have the potential to become world leaders in their fields. As a consequence of effective hiring and retention, all but one of our current Professors have been appointed by internal promotions.

Since 2014, all new hires have been lectureships, except one Reader. Most joined us having just finished their PhDs or post-docs. Two joined us with some experience as lecturers elsewhere.

The success of our staff development is shown by promotions within Birkbeck or to posts elsewhere. At Birkbeck, 2 to Professor; 4 to Reader; 1 to Senior lecturer then Reader, and 5 to Senior Lecturer. Six have moved to other institutions and achieved promotion there

2.2 Early career researchers

As noted above, since 2014 almost all new appointments have been of early career researchers. There are well established and effective departmental and College structures to support these early-career staff. Birkbeck received the HR Excellence in Research Award in 2017, affirming the College's progress towards the implementation of the Concordat to Support the Career Development of Researchers, and Fairbairn is a member of the Academic Advisory Board overseeing the implementation of this action plan.

Early career researchers are supported with reduced teaching and administrative loads and assigned a Mentor from their research group, plus a senior member of staff as their Probationary Advisor. The Mentor and Probationary Advisor guide the development of the early-career research agenda, identifying appropriate opportunities for training, research funding, and possible collaboration with other researchers.

Our new junior faculty have quickly integrated into the department's research culture, through their contributions and organisation of internal and external seminars and their collaboration with existing staff. The success of this support for early career researchers is evidenced by their outputs and success in small-grant applications.

2.3 Staff development

The department has a culture of openness and collaboration. Research and career development issues are often dealt with organically and informally through face-to-face meetings, seminars, and the termly meetings of the research groups. Alongside these informal interactions there are also formal institutional procedures to provide staff support and guidance in their career development. The Professors meet annually to review the research and other achievements of junior staff, to

advise on promotion, and provide feedback.

Each year, all staff members, including Professors, undergo a compulsory academic review in which achievements, research projects and grant application plans and issues can be discussed with a senior colleague who gives advice and then feeds back to the College regarding the resources necessary to support the individual's research, personal and career development. Such interactions also allow the Professors to lead by example, say by developing joint applications for research funding.

The College encourages all academic staff to take sabbatical leave, normally one term in nine. Since 2014 EMS has improved its sabbaticals policy significantly. Research group leads now monitor sabbaticals to ensure all researchers have equal access, and proactively follow up on those who seem to be "falling behind" with their due leave. Sabbaticals are covered by reallocating teaching duties to other department members, fostering the rotation of teaching, widening colleagues' experience, and revitalising the teaching programme. Since the previous REF nearly all eligible colleagues have used their sabbatical rights.

EMS encourages staff to apply for external research funding, although as noted earlier, with a relatively junior Department at the moment we have a strategy to build this capability slowly and in a sustainable manner, which will come to fruition in the next census period. The College Research Office provides regular bulletins on external funding opportunities and also provides grant-writing training sessions. The School Programme and Research Development Manager works with the School Impact Officer to support academic staff in developing external grant applications. Within the department, colleagues who have been successful in obtaining external funding provide individual support and mentorship to others considering research grant applications.

All academic staff attend regular training on topics such as PhD supervision, grant applications, research impact, project management, line management, faculty recruitment and workshops on unconscious bias organised by the BEI and the College.

The Birkbeck Public Engagement Awards recognise and celebrate researchers undertaking innovative and exemplary public engagement activities. Beckert's submission on the role of academic research to measure the impact of competition on the quality of patient care was deemed as highly commended in 2020 Public Engagement Awards.

2.4 Research students

The Department has a well-established MPhil/PhD research training programme and in this census period all academic staff have supervised research students as first or second supervisor. Our research students are integrated into Department activities through teaching, active participation in seminars, representation at Department meetings. Our part time PhD students create links with their employers and we maintain close links with our PhD graduates. Numerous current and recently-completed PhD students publish research alongside their supervisors and other members of the department. In the academic year 2019-20, we had (by headcount) 59 MPhil and PhD students (40 in Economics and Finance and 19 in Mathematics and Statistics). Over the census period we had 37 PhD completions (in parenthesis): 2013-14 (1) 2014-15 (6), 2015-16 (3), 2016-17 (8), 2017-18 (7), 2018-2019 (3) and 2019-20 (9), maintaining the numbers seen in the previous REF census.

The Department has been a member of an ESRC doctoral training partnership during the census

period, initially the Bloomsbury DTP, subsequently the UBEL (UCL Bloomsbury and East London) DTP. UCL and Birkbeck EMS are the lead institutions in the UBEL Economics and Quantitative Social Sciences pathway. Over the census period the UoA has secured 9 studentships from UBEL. In addition, during the census period the College and BEI provided funds for 15 of our MPhil/PhD students. Two students were funded by external sponsors.

The Department has supported two to three graduate teaching assistants (GTA) at a time over the current cycle, whose holders enrol as full-time research students with fee remission, alongside an opportunity to gain teaching experience and training. The teaching experience is especially valuable, given that Birkbeck students are often well informed working professionals.

Research students are initially enrolled as MPhil candidates, assigned a primary and secondary supervisor and given a dedicated workspace and desktop computer in an office close to their supervisors. New research students in Economics and Finance are required to take a programme of advanced taught courses, within the first year for full-time students or the first two years for part-time students (who make up a significant proportion of the Birkbeck student population). These courses are tailored to individual training needs and have for many years been offered in collaboration with UCL and more recently with Royal Holloway and City University. PhD students in Mathematics and Statistics have access to taught courses via the London Taught Course Centre for students in mathematical sciences.

Each term a selection of our students present their research at a 'PhD Jamboree', attended by students and staff, to develop their presentation skills, to obtain feedback on their research, and to meet one of the requirements to upgrade from MPhil to PhD. Upgrade is determined by the Department Research Committee and also requires the completion of a satisfactory and substantive chapter, refereed by two faculty members other than the student's primary supervisor. PhD Supervisors report on their students' progress annually to the Departmental Research Committee, which decides on progression to the next year of the programme, which is distinct from the upgrade process. The Department Research Committee reports termly to the School Research Committee, which oversees and monitors research student recruitment, funding, progression and completion across the School.

For final year students, our supervisor-led training prepares for their PhD viva. The PhD programme director provides detailed information on the specifics of the oncoming PhD job market and organises mock job market interviews. The EMS website hosts a job market page for our job market entrants in that year. Our website also contains past placements information.

Our research centres provide structures where our current and former PhD students remain in contact with the Department and with each other. For example PhD students working in macroeconomics are affiliated with the Birkbeck Centre for Applied Macroeconomics, BCAM, and can publish in its working paper series, participate in its annual conferences and present their work at poster sessions. These links are maintained with PhD alumni who regularly present at BCAM conferences.

The Department provides funds (up to £1000 per student per year) to enable PhD students to present work at internationally recognised conferences in addition to the discipline specific training provided by the supervisor and within the Department and at the College level. At the College level, the Graduate Research School (BGRS) also provides training courses on generic research and communications skills. Prospective PhD job market candidates also benefit from the global Three-Minute Thesis (3MT) competition, where the students learn how to make the classic

“elevator pitch”.

Since the 2014 REF, our research student training has been further enhanced by the following initiatives:

- a. Since the 2018-19 academic year, a new PhD training collaboration with Royal Holloway and City University London led to sharing of MPhil level courses in core areas and facilitated interaction between academic staff and PhD students among participating institutions.
- b. Since the 2019-20 academic year, two new MRes programmes (Economics and Financial Economics) prepare prospective MPhil students with necessary analytical skills. MRes students are assigned an MRes supervisor at the outset who guides them towards MPhil studies.
- c. Since 2016, the Research Committee adopted a completion encouragement policy for final year research students

Our PhD graduates move on to posts in academia, public bodies and the private sector. .

2.5 Equality and diversity

The department strives to provide an inclusive environment in which all staff and students can develop their personal and academic potential. This is supported by initiatives at the college level. Birkbeck is a member of the Stonewall Diversity Champions programme and is a level 2 Disability Confident Employer. The College also holds a college-level Athena SWAN Bronze Award.

The Athena SWAN Charter supports equality of opportunity for women working in higher education and research. Since 2015, it has expanded its focus from STEMM subjects to recognise work in arts, humanities, social sciences, business and law. This meant that within this REF period, the department was able to apply for the first time for a department-level award. We made our submission in November 2017 and received the Bronze award in Spring 2018. The department is also registered as a Supporter of the London Mathematical Society’s Good Practice Scheme for advancing women’s careers in university mathematics departments. Due in part to the fact that our teaching takes place in the evening, a culture of flexible working is the norm within the department, with many staff working from home one or more days per week. Seminars held within the department typically take place early in the afternoon; this timing is family-friendly and avoids clashes with teaching. All staff are required to undertake equality and diversity training, as well as unconscious bias training. Staff involved in recruitment panels are also required to have taken recruitment training, which also has an equalities component. We ensure that all recruitment panels within the department contain at least one man and at least one woman. The department has a Caring Responsibilities Working Group, currently chaired by Prof Sarah Hart, whose purpose is to create, maintain, update and publicise key resources for staff with caring responsibilities in the department, and their line managers and/or probationary advisors. This includes support around maternity, paternity and adoption leave, as well as advice on flexible working and/or compassionate leave for parental and other caring responsibilities, such as caring for elderly or disabled relatives. The group is also considering the issue of support for staff returning from long-term leave, including sick-leave and compassionate leave as well as parental leave. The department has a transparent workload model and the workload data for all staff is reported annually at a department meeting. The model itself assigns tariffs for all teaching and administrative activities, with the aim being that by balancing these aspects of workload we can help promote equality of time staff have available to carry out their research. Birkbeck holds regular workshops for staff on preparing to apply for promotion, and the college promotions procedure

includes the use of personal circumstances forms so that periods of family leave etc. can be taken into account by the promotions panels. The department's process of having colleagues submit CVs annually in order to identify staff with a case for promotion was commended as good practice in the feedback we received on our 2017 Athena SWAN application; there have been multiple instances of successfully promoted colleagues, both male and female, reporting that they would not have thought they were ready to apply if it hadn't been for the department's recommendation that they do so. The ratio of women to men on our REF reading group involved in reading, rating and selecting the outputs for our submission is slightly higher than the ratio of women to men in the pool of people being submitted in this unit. The college has carrying out a three-round process of output selection, and after each round is analysing the distribution of outputs across staff with respect to multiple protected characteristics. Following the first selection round no statistically significant imbalances were reported on our unit's selection; as a unit we have continued to engage with this process throughout the remaining rounds in order to ensure our selection is free of bias.

3. Income, infrastructure and facilities

3.1 Research funding and research income

Our strategy for generating research income has been two-pronged, with strands relating to grant income on the one hand, and the development of external funding opportunities through our alumni network and our consulting activities on the other.

Our strategy for obtaining grant income has been to focus on developing a culture of regular applications, with particular support for our early-career researchers. We have brought in the expectation that active researchers will submit regular grant applications in support of their research. We actively encourage our early-career researchers to build up a record of success in obtaining small and internal grants in order to establish the profile necessary for success in obtaining grants for larger projects. This approach is reflected in the fact that during the census period our number of grant applications has increased significantly as compared to the previous REF cycle (26 versus 17). There have been notable successes in EMS during the period: Beckert received an ESRC grant (£115K) for the analysis of "Vertical Contracting in Intermediate Goods Markets" (ES/M007421/1) together with Howard Smith (Oxford); Kapur, Smith and Beckert together with colleagues at NIESR received a contract (£65K) on estimating food and drink demand elasticities', funded by the Department for Environment, Food and Rural Affairs (Contract ID: 29013). Wright together with Ghate (Indian Statistical Institute and MPC Reserve Bank of India (RBI)) and Das (RBI) received a small grant from PPRU for research on estimating potential output and its link with capital deepening in India, which helped fund Wright's visit to RBI in 2019. Aksoy was a resident research fellow at the Banco de Espana during April-June 2017 funded by the BdE. Geman received a €100K EU grant as a partner in an Erasmus Knowledge Alliance grant on 'Green Energy Finance', a project which involves 14 partners from Europe and Brazil, 7 universities, and 7 companies in the energy sector to create a two-year MSc programme (612408 – EPP-1-2019-1-EPPKA2-KA).

EMS provides funds to support individuals' research and conference participation (about £1000 pa). The BEI School further provides grants for conference travel (up to £750 per year per person) and to support research (grants up to £10000 awarded through a competitive application process). During the October 2014–October 2020 period EMS received BEI School funding for 23 small research grants (aggregate amount around £50,000); 9 impact grants to organise workshops and

conferences (around £26,000), and 32 conference travel grants (£26,000). Finally, during the census period, EMS researchers in the Quantitative Health cluster received research funding in the order of £68,500 through the competitive Wellcome Institutional Strategic Support Fund (ISSF1 and ISSF2) managed by the College (this funding is restricted to research with a health focus); Chandna received £4,800 through the College's Research Innovation Fund for her research on generalized nonnegative matrix factorization models; Daripa and Kapur received £9,600 from the College Newton Fund.

In addition, several small grants were obtained by Hart, Pokrovskiy, Paterson, Peri, Rattan from the London Mathematical Society. Beckert obtained an Erasmus Mobility Grant on "Protecting Vulnerable Customers in Essential Markets", with Thomas Gehrig (Vienna) and will organise a workshop with the Austrian Financial Markets Regulator and Ministry of Finance. We also receive 'in-kind' grants.

We receive regular external financial support for conference/workshop organisation. Hart received a grant (£5000) for a "Women Trailblazers in Mathematics" workshop and London Mathematical Society grant of £2,800 for a Women in Mathematics day. Aksoy received small grants (£2,500) for BCAM conferences. Likewise, Fairbairn obtained a small grant from the London Mathematical Society for workshop organisation.

The second part of our strategy is to exploit external connections that can lead to research collaboration and opportunities for developing impact, as well as potential research funding. Another aspect of this is to nurture alumni relations. for example the Sundstrom Reader in Mathematics significantly strengthened the Combinatorics research cluster.

As outlined in 2.3., while we actively seek external funding opportunities, internal (College and BEI) funding continues to play an important role for our research activities.

3.2 Organisational and operational infrastructure

EMS has a Seminar Room for its own use located conveniently in the heart of the Department in Birkbeck's main building in Malet Street to accommodate its many research seminars and related activities.

EMS benefits from comprehensive support for IT with a dedicated member of staff, a very wide range of software, and good provision of data including DataStream and Bloomberg for financial research. The BEI Research Development Officer, Impact Officer, and Finance Officer support the department's research development, exploitation and communication.

Birkbeck's library provides a good range of journals, has a very extensive e-library with journals and other materials, and a satisfactory budget for buying books, both for research and teaching. Besides Birkbeck's own library facilities, the department is within walking distance of some of the world's richest collections of libraries including the University of London Senate House Library, the British Library, the London School of Economics and University College London.

4. Collaboration and contribution to the research base, economy and society**4.1 Research collaborations, networks, and partnerships**

The Department has strong links with international research communities in economics, mathematics and statistics through research collaborations and various visitor initiatives. Department members have a large network of academic collaborators in the UK, in Europe and the US including former Birkbeck PhD students/ colleagues. External networks of fellow researchers have made an important contribution to sustaining vibrant research groups, as evidenced by the high proportion of papers with external co-authors.

Several members are affiliated to international research networks, e.g. CEPR: (Sibert), CESifo (Aksoy, Sibert, and Zoega), Kiel Institute for World Economics (Sibert), IZA (Gomes). Smith is an elected fellow of the International Association of Applied Econometrics.

In the public sector, EMS members work with many organisations.

Encouragement for collaborative research is largely informal, but is actively supported through initiatives such as School and departmental research funding, which supports visits to and from collaborators, and through our sabbatical leave programme, which provides the time necessary for more extended periods of intense direct collaboration. BEI School research grants particularly encourage applications that will be used to “pump-prime” large collaborative efforts. For example, Paterson’s grant funded Huczynska’s (St Andrews) week-long visit to Birkbeck. Similarly Basso’s (Banco de Espana) regular Birkbeck visits were in part funded by Aksoy’s grants.

Some key examples of research collaborations are:

- Beckert with Smith (Oxford) and Takahashi (Johns Hopkins) on industrial organisation for the Association of Competition Economics (ACE).
- Kapur with Heyes (Ottawa) on environmental regulation.
- Noble with the Heilbronn Institute for Mathematical Research.
- Paterson on combinatorics and cryptography with a network that includes Stinson, Dept of Computer Science, U Waterloo, Canada; and researchers in the mathematics and information security group at RHUL.
- Smith with Pesaran (USC) and Anand (Open University);
- Zoega with Phelps, 2006 Nobel laureate, Katsimi (AUEB), and Jensen (Copenhagen).

The Birkbeck Centre for Applied Macroeconomics attracts short and long term visitors: such as Basso (Banco de Espana) and Kempf (Paris, Saclay). Likewise, Okano (Nagoya, Japan) visited BCAM during the 2018-19 academic year.

4.2 Relationships with research users and the wider public

Our three impact case studies show the strength of our relationship with research users. Aksoy and Smith’s research on demographic structure and macroeconomics informed many central banks/policy makers and the wider public. Beckert’s research on competition and patient choice influenced health authorities’ decisions on hospital/NHS trust mergers. Schroeder’s research on equity duration affected financial investment decisions made by major international companies. In all these cases we developed relationships with key research users, e.g. Aksoy and Smith with

Banco de Espana and ECB, Beckert with NHS, Health Foundation, Co-operation and Competition Panel, Schroeder with Boston Consulting Group, in turn leading to further research initiatives.

4.3 Contributions to the economy and society

EMS staff engage with policymakers and the public/private sector, in various advisory roles or in a policymaker role.

- Sibert and Zoega were appointed to the Monetary Policy Committee of the Central Bank of Iceland in 2009 following the collapse of the country's banking system in late 2008. Sibert served until 2012 and Zoega is still on the Committee.
- .
- Sibert was a member of the Panel of Economic and Monetary Experts of the Committee of Economic and Monetary Affairs of the European Parliament.
- Since 2007 Beckert has been a member of Oxera Economic Council (chaired by Prof. Sir John Vickers). The Council annually meets with EU Commission staff in Brussels to discuss issues of competition affecting the economic interests of the EU.

Another example of engagement with diverse communities is Hart's significant outreach and public engagement work, with numerous public lectures and visits to schools and colleges over the REF period. These included a guest lecture at Gresham College in 2017 at the Museum of London, a conference talk for 6th formers attended by 900 students, and several talks/workshops to smaller school groups. She was the invited Mathematics expert on Channel 4's "Child Genius" programme, broadcast in May 2019 and chaired a panel on symmetry and asymmetry in mathematics, music and poetry, as part of Birkbeck Arts week on May 24th 2019, with pianist Iain Burnside and poet Fran Lock. In 2020-21 Hart is giving online public lectures as the Gresham professor of Geometry on [Mathematics in Music and Writing](#), part of a three-year exploration of Mathematics, Culture and Creativity with themes of symmetry drawing inspiration from her research in group theory.

We regularly contribute to wider College outreach events, such as Business Week and Birkbeck Inspires, where we showcase our research and engage with a wider audience.

4.4 Contribution to the discipline

Members of the Department contribute as members of editorial boards on academic journals in the UK and internationally. These include:

- Beckert: co-editor of the Manchester School.
- Geman: associate editor of the Journal of Energy Markets, Journal of Alternative Investments and Journal of Financial Services Research.
- Paterson: editorial board member of Designs, Codes and Cryptography.
- Psaradakis: associate editor of Econometrics and Statistics and editorial board member of Journal of Probability and Statistics.
- Schroeder: editorial board member of Journal of Asset Management.
- Smith: editorial board member of Journal of Conflict Resolution and Journal of Peace Research.
- Hart is a member of the UKRI Future Leaders Fellowships Programme Peer Review

College, a Vice-President (President from January 2021) of British Society for the History of Mathematics and will be a member of the Advisory Board for the Greenwich Mathematics Centre.

Notable prizes and recognitions received by Department members:

- Gomes received the Austin Robinson Memorial Prize for the best paper published in the *Economic Journal* by an author who is within five years of receiving their PhD;
- Pokrovskiy was jointly awarded the European Prize in Combinatorics, recognising contributions in Combinatorics, Discrete Mathematics and their Applications by European researchers aged 35 and under.

We organise regular conferences. Some are specialist research meetings but many include public sector and industry participation. Examples include:

- Aksoy and Gomes: annual BCAM conferences and policy talks by eminent academics/policymakers since 2014.
- Beckert: with Smith (Oxford), an ESRC-funded conference on the Empirical Analysis of Vertical Contracting and Bargaining (June 2018)
- Fairbairn: the London Algebra Colloquium in Autumn 2018.
- Gomes: BCAM workshop on public employment (November 2020)
- Hart: annual British Society History of Mathematics (BSHM) conferences, held at Birkbeck each year since 2015.
- Hart: the London Mathematical Society “Women in Mathematics” Day held at Winton in 2017, as was the Winton “women trailblazers in mathematics” conference.
- Paterson is the programme chair for the 18th IMA International Conference on Cryptography and Coding in December 2021.
- Radice organised an interdisciplinary conference on Big Data Analytics and Applications in Economics, in June 2017.
- Rattan was on the organizing committee of FPSAC’17, the 29th International Conference on Formal Power Series and Algebraic Combinatorics.

Examples of a wide range of keynote speeches and distinguished presentation invitations include:

- Geman at the ‘Women in Quantitative Finance’ conference (April 2019) and at the MIT symposium celebrating Robert Merton’s 75th birthday and lifetime of work (August 2019).
- Geman was also an invited speaker on the future of extracting industries at Chatham House (April 2019).
- Paterson at the Postgraduate Combinatorics Conference (LSE, 2018), and at the first London Crypto Day (Royal Holloway, 2017).
- Smith at the CFE-CMS computational conference with over 1600 attendees (Senate House, University of London, December 2017)

All members of the Department are extensively involved in external peer reviewing, some reviewing more than a dozen papers each year. Likewise several members of the department review grant applications for major funders, such as the ESRC. We examine a large number of PhDs in the UK as well as abroad (e.g. for Paris-Saclay, Paris-Cachan, Prague, Copenhagen, Cape Town, Monash among others).