Network Journeys: For the Love of Operational Research

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Inaugural Early Career Researcher Workshop
Lancaster University, England, September 9-10, 2018

A big thanks to Professors Kevin Glazebrook and Graham Rand of Lancaster University and to Ms. Charlene Timewell of The OR Society for the opportunity to speak with you today.

It is such an honor and pleasure to be speaking to you today!

Outline

- At the Beginning
- The Job Market for an OR PhD
- It's About the Research
- Where Do Research Ideas Come From?
- Developing Your Philosophy of Research
- What About Collaborations and Building Your Networks?
- Publishing in High Quality Journals
- What Makes an Article Publishable?
- Other Important Points
- The Competitive Environment
- Don't Give Up!
- Why the Hard Work is Worth It
- Work Life Balance
- Some Final Thoughts

At the Beginning

At the Beginning

Do you recall the first time that you became fascinated by Operational Research?

- Was it an educator, whose enthusiasm and love for the subject got you captivated?
- Was it an application that captured your attention?
- Were you inspired by the world around you and you wanted to make things better?
- Was is a tool or algorithm that intrigued you?
- Was it a software package that showed you the power of OR?
- Was it something about technology that drove you to dig deeper?

At the Beginning - Brown University

The love of Math, which represented Truth to me, as well as the love of different languages, came early.

It was the education at my alma mater and the faculty that inspired me, and that drove me to greater learning.

Having a family that very much valued Math and Engineering also provided great support.

Division of Applied Mathematics

At the Beginning - Brown University

The first OR problem that I was asked to formulate and solve was in an undergraduate class. It was a **Linear Programming problem** on packing a backpack for a hiking trip with your favorite foods and subject to weight and other constraints. I was "hooked!"

After I received my PhD, I met **Professor George Dantzig of Stanford University**, the developer of the simplex method and a Father of OR! He came to the first presentation that I ever gave at a conference, post PhD, and it was at MIT.

Working in Industry

After receiving degrees in Applied Mathematics and Russian Language and Literature from Brown University, I became a systems analyst, working as a consultant in the defense sector at the Naval Underwater Systems Center near beautiful Newport, Rhode Island. I was newly married.

Within a week I was trained to write assembly language code and to implement software for submarines so that they could transit without being detected by the enemy.

Working in Industry

Very soon I realized that I did not like having a boss - on one project that took me three months I was told that it was a three year project!

Luckily, a company paid for my Master's at Brown University, so I commuted 90 miles roundtrip, ran marathons, and also took classes, competing with full-time students. **At that point I did not know how to drive!**

I had one supervisor, who was a civil servant, and saw my promise. He funded me to do research - the research involved developing various network models from submarine avoidance detection to modeling computer networking systems. **I got to have my first paper published in a conference proceedings organized by MIT and held at the Naval Postgraduate School of California**. I was the only female speaker and one of the very few non-admirals, and top military brass. I did not even have a Master's.

Going Full-Time to Grad School

After working in industry, I knew that I wanted to get a PhD. My college room-mate, who was also an Applied Math major, had told me about a female professor - **Dr. Stella Dafermos**, and I sought her out. Stella was the second female to have received an OR PhD. She liked the fact that I was good at coding and **she was an expert on transportation and networks**. I became her first PhD student.

EQUILIBRIUM MODELING, ANALYSIS AND COMPUTATION:
THE CONTRIBUTIONS OF STELLA DAFERMOS

ANNA NAGURNEY
University of Massachusetts, Amherst, Massachusetts
(Received June 1990; accepted August 1990)

This memorial tribute to the late Stella Dafermos summarizes her contributions to equilibrium modeling, analysis, and computation, and provides a list of her published papers.

On April 5, 1990, with the death at 49 of Stella Dafermos, Professor of Applied Mathematics and Engineering at Brown University, Providence, Rhode Island, the operations research community lost one of its early woman doctorates. Throughout her quarter-century career she dedicated herself to developing rigorous mathematical formalisms for modeling, analyzing and making computations related to competitive equilibrium systems that spanned applications from congested urban transportation networks to multicommodity trade. Beginning with her 1968 doctoral dissertation, "Traffic Assignment and Resource Allocation in Transportation Networks," directed by F. T. Sparrow at Johns Hopkins University, which focused on the study of system-optimized and user-optimized transportation networks, she initiated a theme of advancement of methodologies by which the behavior of complex systems could be captured and studied.

EQUILIBRIUM MODELING

In her first paper, based on her thesis and published in 1969, she proposed convergent equilibration algorithms that simulated the adjustment behavior of travelers on a congested network operating in their own self-interest in choosing their routes. The governing equilibrium conditions, due to Wardrop, reflected that only the minimum cost routes connecting each origin/destination pair would be used. These algorithms took advantage of the problem structure and were later extended in papers published in 1971 and 1972 to network models that allowed for interaction among users of the system via the link cost functions. In her 1969 paper she also focused on stability issues, which began the theme of qualitative analysis of equilibrium patterns that was also to pervade her scholarly work.

These network equilibrium models, as well as the integrated models that allowed for both location and route choice, developed in her paper of 1976, were formulated as optimization problems, with the observation that the equilibrium conditions governing these problems were actually the Kuhn-Tucker conditions of an appropriately constructed optimization problem. Interestingly, parallel to these developments in nonlinear networks, the economics community was reformulating spatial price equilibrium problems, in which commodities are produced, consumed and traded, subject to transportation or transaction costs, as optimization problems. However, the assumption required for such a transformation—that of *symmetry*, in which cross-effects of various interactions had to be identical—precluded the realistic modeling of multiple modes of transportation and different classes of users of a given system, as well as multiple commodities. Moreover, the objective function thus constructed, although convenient and essential given the state-of-the-art at the time, was artificial. Furthermore, equilibrium problems, by their very nature, involve more than a single agent and objective function, with interactions among the agents, and, hence, the objective functions being the rule rather than the exception. To overcome such shortcomings, a methodological advance was needed.

In 1980 Stella made a fundamental discovery by observing that the equilibrium conditions of the traffic assignment problem actually had the structure of a variational inequality problem. Although the theory of variational inequalities had been introduced over a decade earlier for the study of partial differential equations, the emphasis there was on infinite-dimensional problems arising in mechanics, and its use as a powerful tool for equilibrium analysis in operations research was left unrealized. Stella's identification of network equilibrium conditions with a variational inequality problem ope-ned up new horizons for mathematical modeling, analysis and the efficient computation of more general equilibrium systems than had heretofore been possible. With this

Subject classifications: Economics: solution of equilibrium problems. Networks/graphs: equilibrium modeling and computation. Transportation: formulation and solution of multimodal problems.

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Picking a Dissertation Advisor

Picking a dissertation advisor is very important since it starts you on your OR journey.

Stella Dafermos was the **only female Professor** at that time at Brown and held appointments in Applied Mathematics and Engineering.

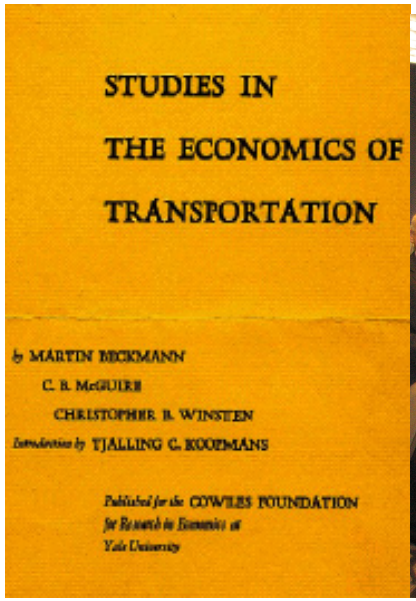
We ended up co-authoring multiple papers together that were published in such journals as *Operations Research*, *Mathematical Programming*, and *Transportation Research B*.

She had the highest of standards and we would write and rewrite each paper multiple times.

I very much enjoyed sharing a hotel room with her often at OR conferences, for as long as she could and we spoke on our work in The Netherlands, Greece, Japan, and the US.

Professor Martin J. Beckmann

Also, on my dissertation committee was the renowned economist - regional scientist - operations researcher, Professor Martin J. Beckmann, who was later the recipient of the Robert Herman Lifetime Achievement Award of the Transportation Science Section of INFORMS. His motto was: **"See the world before you leave it"**.



I organized special sessions at the INFORMS San Francisco conference in honor of the 50th anniversary of the publication of his book. Beckmann passed away in April 2017 at age 93.

Academic Genealogy - Standing on Shoulders of Giants

My 18th PhD student, Dr. Michelle Li, presented me with my academic family tree with academic forefathers including **Galileo, Newton, and Maxwell**. I have chaired 20 PhD committees, and am supervising 4 doctoral students now.

A remarkable number of my academic ancestors have received PhDs from British universities, notably, from Cambridge and Edinburgh.

The Job Market for an OR PhD

The Job Market for an OR PhD

While you are busy finishing your PhD and then receiving your diploma you will also be on the job market.

The demand for OR expertise is immense so you should have multiple, exciting options.

The Job Market for an OR PhD

Choices, choices, choices!

- Do you want a job in academia, or in industry, government, or the nonprofit sector?
- If you desire an academic position, would you like a postdoc first?
- Would you prefer teaching at a major research university or a less-intensive research university?
- Do you have an **optimal** location in mind?
- What types of constraints are you dealing with?
- Remember, your first job post PhD may just be a stepping stone.

Always do the best work possible, which will guarantee that you are eminently "movable".

Be open-minded and avail yourself of opportunities, when they become available to you. Also, seek out opportunities to grow.

The Job Market for an OR PhD

In your job search, be the consummate professional.

Your dissertation advisor can be a big asset in your job search.

During the interview stage (and beyond), make sure that **you sustain a high level of energy**. So, take care of yourself, since searching for a job is a time-consuming and intense process, but definitely worth it!

Remember to followup with nice thank you notes.

The professional community is global but relatively closely connected - how you handle yourself affects your reputation.

It's About the Research

It's About the Research

We are all here because we care about research – in doing it, publishing it, and disseminating it.

You are very lucky, since you are in the field of Operational Research in which there are many open and important problems to research! Also, we don't require a large lab/scientific infrastructure to do our work.

As researchers and scholars, we care about adding to the discipline's body of knowledge and, perhaps, beyond.

It's About the Research

I have authored or co-authored over 190 refereed journal articles, 50 book chapters, and 14 books.

I hope to share with you today both professional and personal experiences in this workshop as well as those garnered from other experts.

It's About the Research

Whether it is your first journal article or your 100th, one never gets tired of publishing and seeing one's research and hard work in print!

Also, for every professor, a great joy is seeing one's students publish and succeed.

As a member of many journal editorial boards, and also as a Guest Editor of several special issues of journals, **it is very rewarding to see good papers shepherded through the publication process.**

It's About the Research

Much of my research these days involves supply chains and, of course, networks!

Examples of Supply Chains

Where Do Research Ideas Come From?

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The following recommendations were most frequently mentioned in a survey of stellar scholars in Operations in a study conducted by Dr. Bin Jiang of De Paul University in Chicago:

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- **Intellectual curiosity:** observing the real world, delving deeply into issues, having passion
- **Networking:** discussing problems with colleagues, going to conferences, talking to others even outside your professional circles
- **Reading the literature:** how can you improve on what has been done? Do you have new tools or new ideas for old problems or old tools for new problems?

Taking Part in Conferences is Very Important

Developing Your Philosophy of Research

Developing Your Philosophy of Research

You want your work to have a high impact on society and the profession.

• *Work on problems that you enjoy and follow your interests*. It is essential to have passion for the research that you are doing. Passion is what drives research quality, creativity, innovation, and impact.

• *Begin with small ideas* and then extend them as far as is possible to increase the scope and applicability.

• *Focus on the big problem*, which, when you publish the results, will get cited for years to come. You will take pride in your work many years from now as you look back at it.

• *Be careful about doing derivative work*, although it may be OK to create a portfolio of research.

What About Collaboration and Building Your Networks?

What About Collaboration and Building Your Networks?

Some suggestions for selecting the right (for you) researchers to collaborate with:

- Select co-authors that you are personally comfortable with.
- Research requires stamina and dedication, so your co-authors should have the same level of interest and dedication as you.
- Seek out collaborators with whom you can push through new frontiers – with different skillsets, knowledge of different methodologies, and applications.
- Collaborate with those that fuel your intellectual interests and that generate excitement and ideas about the research problem.

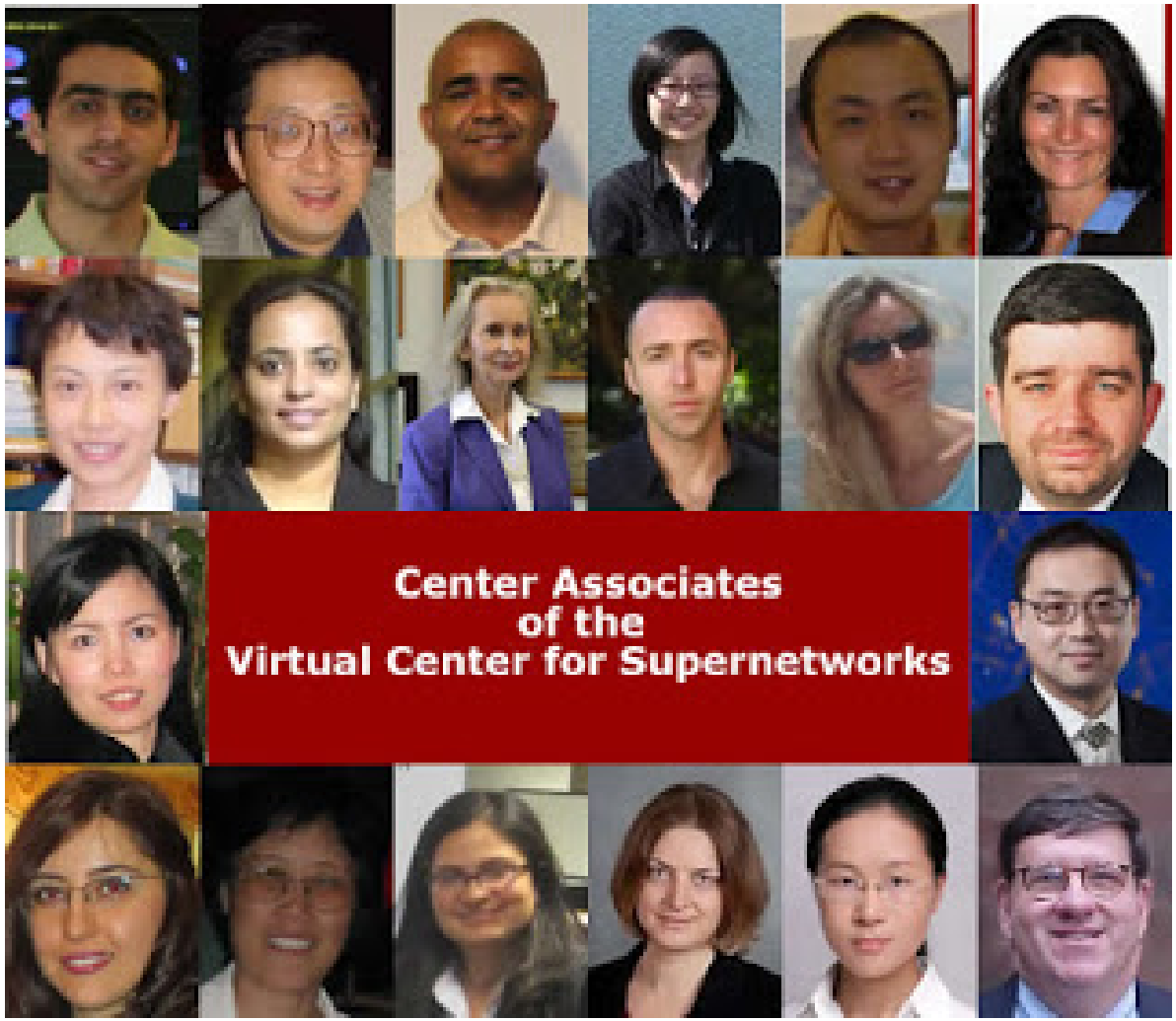
What About Collaboration and Building Your Networks?

Collaborations may also enable you to receive funding for your research.

This could enable more trips to conferences, more student support if you become a professor, etc.

Always do your very best! Also, integrity is essential to professional success!

What About Collaboration and Building Your Networks?



Places that Collaborations and Networks May Take You

Interview on Broadway in NYC for *America Revealed* PBS TV show on March 15, 2011

Places that Collaborations and Networks May Take You

Yalta, Ukraine with my taxi driver Igor

Buenos Aires, Argentina and the Blue Lagoon in Rejkyavik, Iceland

Places that Collaborations and Networks May Take You

Lancaster University in England, of course!


Oxford University and Imperial College


Publishing in High Quality Journals

Beware of Predatory Journals

Credible journals

Peer review, Revisions, Rejections

Predatory journals

Greetings, We Adore Your Research!

Which Journals to Publish In?

Journals of The Operational Research Society

What Makes an Article Publishable?

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A publishable paper consists of a trio:

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Contribution – *Be very clear as to what your contribution is to the literature*. Make sure that your contribution is evident right up-front. You must capture the interest of the reader – analogy to a novel (but non-fiction) that keeps the reader turning pages chapter by chapter, section by section.

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Motivation – *Provide the setting in which the work was done and its importance*. Make sure that you cite the relevant literature. Not doing so can anger reviewers and this is not promising. Be clear about any managerial insights and relevance.

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Expression – *Strive for excellence in writing*. Make sure that the paper is well-organized, formatted properly, free of typos and errors, the results are well-documented and explicated, and the manuscript is in the journal format and that it also "looks good." Figures and tables should be carefully drawn and formatted.

What Makes an Article Publishable?

- In a modeling (quantitative paper) we, typically, will have a model section as Section 2, followed by an analysis section, an algorithm or additional methodological discussion, numerical examples and/or empirical analysis. There may also then be a discussion on managerial implications.

One must understand the reality in developing a good model, and it must be theoretically sound. Check whether or not your model reflects reality once it is written up and throughout the development of it.

According to Professor Egon Balas of Carnegie Mellon University:

"Facing a real-world problem, my first approach is to try to capture its essential features into a model that is manageable, even if the answer is far from an accurate representation of it. In other words, to get going, I settle for an imperfect representation. Then I set out to refine by adding those features which can be accommodated without making the problem unmanageable."

Other Important Points

Other Important Points

• **Send your manuscript to the right journal.**
Many rejections are the result of a manuscript and journal mismatch between the submitted paper and the journal's scope or mission. You should have the journal in mind early on in the writing of your paper.

• **You should only submit your manuscript to one journal at a time.**
Your advisor or colleagues can help you to identify an appropriate journal. Look at your citations and if several come from a specific journal – that may be a good potential publication outlet.

Other Important Points

- **Do include a nice cover letter.**

Many authors don't realize the usefulness of cover letters. The letter can further emphasize the importance of the contributions in the paper and can also suggest reviewers for your manuscript. Also, done more rarely, authors can suggest that certain people not review the manuscript for fear of potential bias or may provide recommended reviewers. These may (or may not) be used.

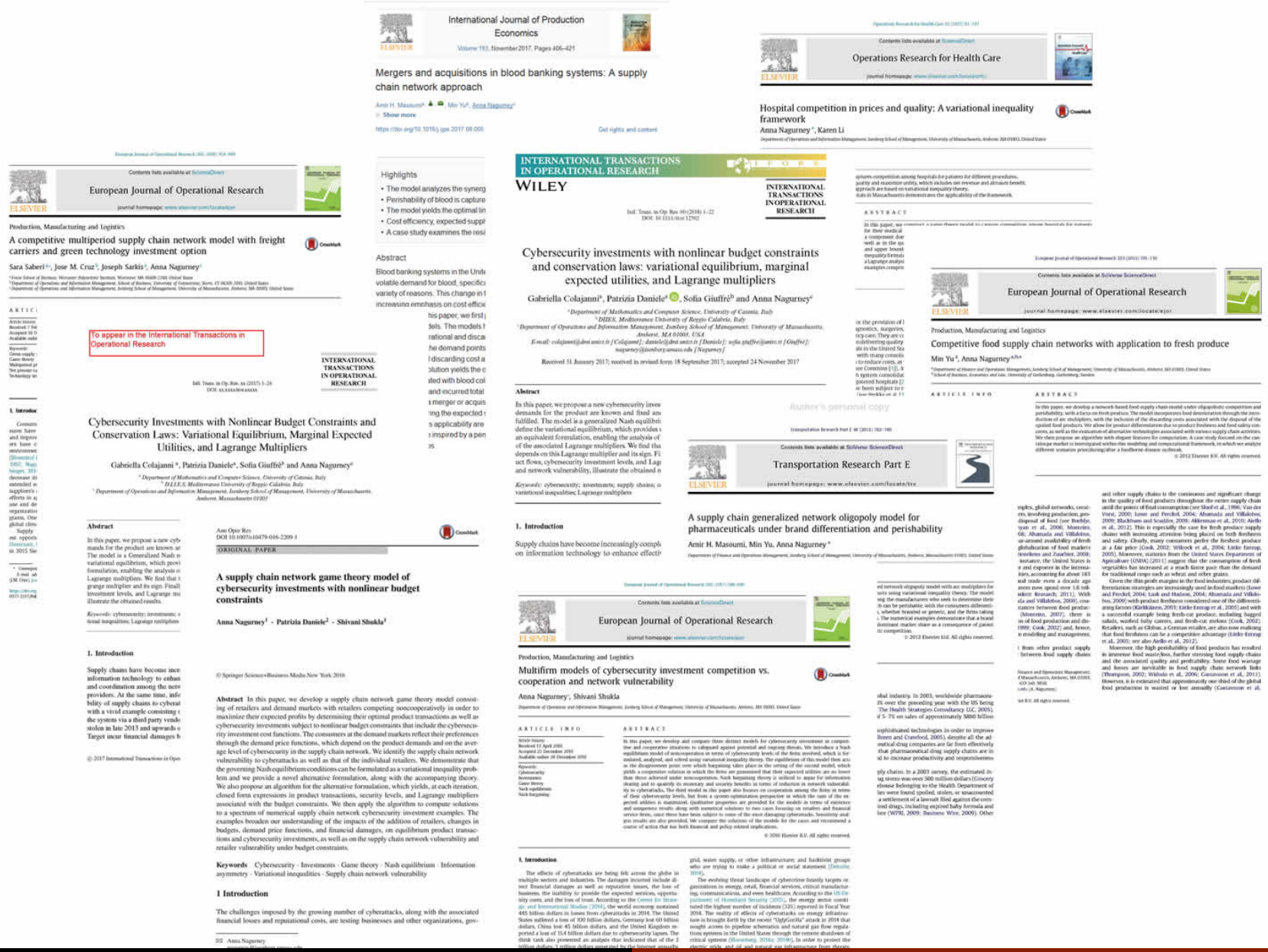
- **Specific journals have certain styles for their papers in terms of the organization.** In looking at other papers in the journal you can find what other authors have done and the style that they have followed. A typical sequence of paper sections may include: title, abstract, introduction, literature review (or this may be within the introduction), sections with results, summary and conclusion section, acknowledgments, followed by the references.

Other Important Points

- **Your will need to be patient (patience is a virtue) and if the process works well you should receive reports back on your paper in 3-4 months. (I have had to wait as long as 12 - 14 months even with prodding....)**

Some journals use double blind reviewing, that is, the reviewers don't know who the authors of the paper are and vice versa.

Admire and Share Your Papers When They Appear in Print



Celebrate Your Publications!

The Competitive Environment

The Competitive Environment

The demand for getting papers published by authors in high quality journals exceeds the supply of journal pages available.

Supply vs. Demand for Publishing

Supply

There are about 10 high quality (top) ranked journals in any a field, each with 12 issues per year publishing 6 articles per issue.

The aggregate journal supply is
10x12x6 = 720
articles per year.

Demand

Worldwide there are about 500 research departments in a field, each with roughly 5 researchers who aspire (may be urged) to publish (at minimum) 1 paper per year in a top ranked journal.

The aggregate demand is
500x5 = 2,500
articles per year.

The Competitive Dilemma Faced by an Author

How do we bridge the gap?

The supply is 720 journal articles per year, whereas the demand by authors is for 2,500 (at minimum) journal articles per year.

This is a challenging (impossible) situation.

Some ideas (suggested by Professor Bezalel Gavish of Southern Methodist University):

- Do research and publish with other authors, then each author can count it in his reports.
- Submit only high quality research results.
- Try to develop new methods to evaluate the research potential of faculty members (more for administrators and universities).

Some of my suggestions: Recognize those who receive awards, give invited talks, get grants, write books, contribute OpEd publications, even affect policy through their writings and communications, etc.

Don't Give Up!

Don't Panic

- **Don't panic**

The overwhelming majority of initial journal manuscripts are rejected at first.

- **Read the reviews carefully.**

In fact, anything aside from a "reject," is a positive review. These include:

- **Accept as is**: happens rarely, although it does happen.
- **Accept with revision**: This means that you need to only make some minor changes.
- **Revise and resubmit**: This may require (a lot of) work but the journal, reviewers, and/or Editor are still interested in your paper!
- **Reject and resubmit**: Although this is clearly not as good as a revise and resubmit, "they still are interested in your paper!"

Don't Give Up!

If a revision isn't invited following the initial rejection, many new authors may toss the manuscript and vow to never write again. Instead, do read the reviews carefully and determine why that decision was made.

If the research needs more studies or if the methodology needs to be changed somehow, if you have a sincere interest in the area, do these things. You can resubmit it as a new paper, noting the differences in the cover letter.

Also, keep in mind that, quite often, unfortunately, a journal will reject an article because it is too novel or too new for its time!

If you feel that your work is valid and good, send the paper to another journal – you must believe in yourself.

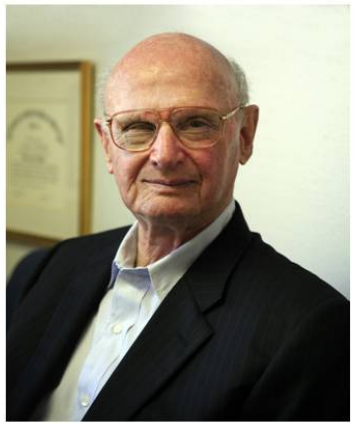
Don't Give Up!

Even Nobel Prize Winners Have Had Their Papers Rejected

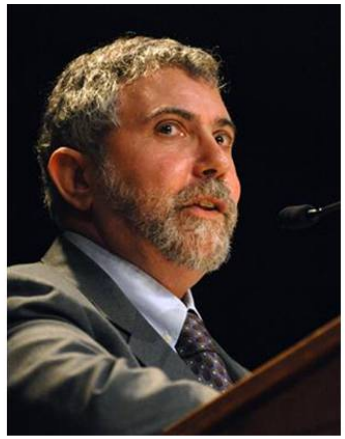
Paul Samuelson
1970 Nobel Laureate

Kenneth Arrow
1972 Nobel Laureate

James Tobin
1981 Nobel Laureate



Harry Markowitz
1990 Nobel Laureate



Paul Krugman
2008 Nobel Laureate

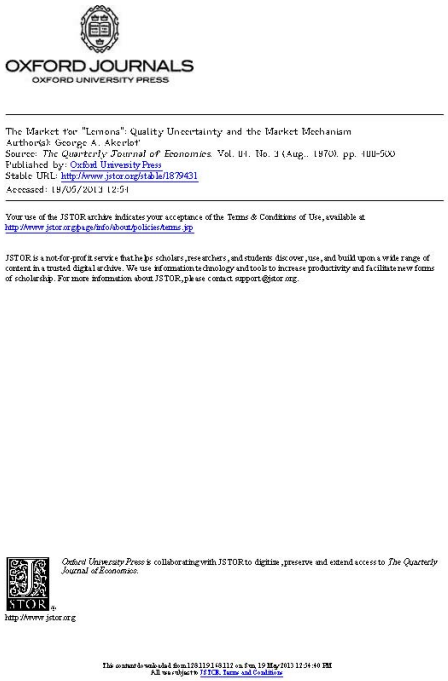
Don't Give Up!

The article, "How Are the Mighty Fallen: Rejected Classic Articles by Economists" by Gans and Shepherd, published in the *Journal of Economic Perspectives* in 1994, is based on a survey of 140 leading economists including Nobel Prize winners and Bates medal winners. The article is available online: http://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.8.1.165

The article has a list of articles and their authors that were rejected and where they were eventually published. Paul Samuelson, the Nobel laureate, acknowledged rejections of some articles of his that are classics. Many "let off steam" in relating their rejection experiences, according to Paul Krugman, also quoted in the article, who later went on to also get a Nobel prize in Economic Sciences.

Don't Give Up!

The paper, "The Market for "Lemons": Quality Uncertainty and the Market Mechanism," by George A. Akerlof, **was rejected three times**, and finally published in *The Quarterly Journal of Economics*.



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The Market for "Lemons": Quality Uncertainty and the Market Mechanism
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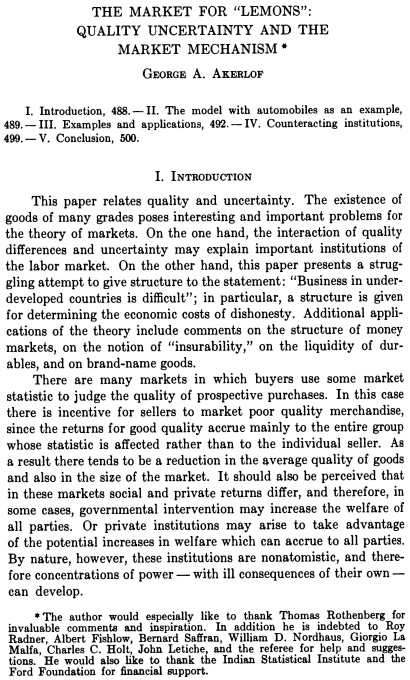

THE MARKET FOR "LEMONS":
QUALITY UNCERTAINTY AND THE
MARKET MECHANISM *

GEORGE A. AKERLOF

I. Introduction, 488. — II. The model with automobiles as an example, 489. — III. Examples and applications, 492. — IV. Counteracting institutions, 499. — V. Conclusion, 500.

I. Introduction

This paper relates quality and uncertainty. The existence of goods of many grades poses interesting and important problems for the theory of markets. On the one hand, the interaction of quality differences and uncertainty may explain important institutions of the labor market. On the other hand, this paper presents a struggling attempt to give structure to the statement: "Business in underdeveloped countries is difficult"; in particular, a structure is given for determining the economic costs of dishonesty. Additional applications of the theory include comments on the structure of money markets, on the notion of "insurability," on the liquidity of durables, and on brand-name goods.

There are many markets in which buyers use some market statistic to judge the quality of prospective purchases. In this case there is incentive for sellers to market poor quality merchandise, since the returns for good quality accrue mainly to the entire group whose statistic is affected rather than to the individual seller. As a result there tends to be a reduction in the average quality of goods and also in the size of the market. It should also be perceived that in these markets social and private returns differ, and therefore, in some cases, governmental intervention may increase the welfare of all parties. Or private institutions may arise to take advantage of the potential increases in welfare which can accrue to all parties. By nature, however, these institutions are nonatomistic, and therefore concentrations of power — with ill consequences of their own — can develop.

* The author would especially like to thank Thomas Rothenberg for invaluable comments and inspiration. In addition he is indebted to Roy Radner, Albert Fishlow, Bernard Saffran, William D. Nordhaus, Giorgio La Malfa, Charles C. Holt, John Letiche, and the referee for help and suggestions. He would also like to thank the Indian Statistical Institute and the Ford Foundation for financial support.

He received the Nobel Prize in Economics for this work.

Don't Give Up!

An editorial in *Nature*, a top scientific journal, stated that it had celebrated the 2003 Nobel in Medicine awarded to Paul Lauterbur, only to have him remind them that the paper had been first rejected and then he appealed the decision.

The *Nature* editorial concludes with:
Nevertheless – **a final moral** – rejected authors who are convinced of the ground-breaking value of their controversial conclusions should persist. A final rejection on the grounds of questionable significance may mean one journal has closed its door on you, but that is no reason to be cowered into silence. Remember, as you seek a different home for your work, that you are in wonderful company!

Some Tips

- **Don't delay making the revisions.**

If you are invited to revise, do it thoroughly and professionally. Reviewers can at times ask for too much, so authors should take each suggestion into consideration, but decide themselves which to implement.

- **Be diplomatic.**

In preparing your response to the reviewers to accompany the revision make sure that you respond item by item and you are diplomatic.

Some Tips

By sending your paper to a journal, you may be asked to review 1 or 2 papers in return.

Do this job well. You may be recognized by appointments to journal editorial boards.

In addition, you can keep up with the literature, in part, by reviewing articles. But don't take on too many reviewing tasks.

Some Tips

It is very important to present your research at seminars and at conferences. In this way you can get valuable feedback.

You may meet journal Editors or Associate Editors. Do make a point of talking to them about your exciting research. Such venues also give you opportunities to network and to disseminate your work. Do go up and introduce yourself to senior and junior researchers whose work you admire.

Why the Hard Work is Worth It

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Also, high quality research enhances education and teaching and your organizations benefit, too.

Work Life Balance

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Do what works best for you!

I did everything **in reverse**:

- **first**, I became a Full Professor;
- **then**, I had a child,
- **and only then** did I get my driver's license!

Some Final Thoughts

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- **Collaborate with the right people (for you):** As noted by Professor Charles Corbett of UCLA: contribution, motivation, and expression are all critical to a publishable paper and "these are multiplicative, not additive."

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- **Opportunities are all around you**: Be receptive to them and take advantage of them.
- **Thank those who have supported you in your OR journey.**
- **And when you are able to**: Do mentor others and advocate for them.

Enjoy the Journey!

THANK YOU!

For more information, see: http://supernet.isenberg.umass.edu