

- Love, marriage, and divorce
- The elite brain drain
- Black swans and fat tails
- Micro-enterprise and capital

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## Love, marriage, and divorce: what's economics got to do with it?

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It is true that falling in love, and love more generally, have nothing (directly) to do with economics. The same to a lesser degree concerns marriage. But with regard to divorce, it often is a lot about economics. Here are some observations about the economics of marriage and divorce. But first a short remark about a connection between falling in love and economics. Both are underpinned by the most basic of facts of life, namely, that resources including (good) potential mates are scarce. In such a world, competition can at times be fierce. It has been so from time immemorial, for food, drink and shelter, and indeed for mates. While the market is in today's world the main mechanism through which competition is mediated, falling in love is nature's contribution (a Darwinian-type selection method) to this "mediation" of competition for mates.

Turning now to marriage and divorce, we can ask why people marry, and in particular, why they stay married for as many years as they do. The answer has to do with economics and economic reasoning. Put in general terms, marriage must enable couples to create an economic "surplus", over and above from what can be secured from staying single. Two main reasons for the existence of such a marital surplus are children and household public goods. In the former case, having and then raising children in an intact household (family) can be better, with some exceptions, than doing so outside of marriage. In the latter case, even without children, cooking a meal for two rather than cooking two meals, having a single house for two rather than two houses, and such like, economizes on costs of living and allow people to make efficiency gains.

Of course, there are things that one cannot do in a marriage that one can when single. So marriage generates benefits to the couple, as a couple, but it also imposes costs on the same individuals. A marital surplus exists if the joint payoff (or utility) between two people from being married exceeds the sum of their payoffs from being single.

Given a marital surplus, the couple implicitly if not explicitly need to negotiate the division of such a surplus, and this is often where conflict can arise. Marriage requires cooperation for the surplus to be created, but it includes an aspect of conflict over the allocation of this marital surplus. This is a typical economic phenomenon. As another example, note that in the quintessential economic scenario of a trade situation between a buyer and a seller, each of them would like to trade for mutual

benefit, but they have conflicting preferences over the price at which to trade.

When the marital surplus becomes too small or fails to exist (in the eyes of the couple), it means the couple should (rationally) divorce, and obtain instead the benefits from being single. The marital surplus can and does change through time. Reasons for this abound. The most obvious one is when one of the partners wants to start a relationship with someone else, and so in that case his or her payoff from leaving the marriage (his or her so-called outside option) suddenly increases in value to the extent that the marital surplus may become negative. Another example is when children grow and leave the nest, which does not induce a change in any spouse's outside option but decreases the benefits from staying married.

Two final points to note about a spouse's outside option, and how it impacts, first, on the share of the marital surplus that he or she can secure and, second, on how government policy might impact on divorce rates. The higher is a person's outside option payoff, the larger is her or his bargaining power within marriage. This, in turn, allows this person to secure a better deal within marriage (i.e., a greater share of the marital surplus). Of course the outside option payoff should not become too large for otherwise the marital surplus will then fail to exist, prompting divorce proceedings.

Given the observations just made, a government can have an impact on both the distribution of welfare within marriage, and on the divorce rate. For example, through labour market interventions, a government can enhance a woman's labour market prospects. This would then make her outside option more attractive, enabling her to secure a better deal within marriage. At the same time, governments shouldn't make that too attractive, for otherwise divorce would take place as the surplus then disappears. Divorce legislation can similarly impact on the size of the marital surplus. The greater the cost of divorce, the greater will be the marital surplus.

There is more to be said about the connection and relevance of economics and economic reasoning to this most fundamental of non-market institutions, the institution of marriage (or, more broadly, to long-term, bilateral relationships). There is a growing literature on the subject in economics starting from the work of the Nobel prize winning economist Gary Becker (see, eg., his classic *Treatise on the Family*).

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## The elite brain drain

How mobile are the world's top research scientists, and do they migrate disproportionately to the richest countries? **Andrew Oswald** and colleagues have analysed data on the migration and productivity of Nobel Prize winners and the world's most highly cited physicists.

There is a large research literature on the "brain drain," but few researchers have looked at migration among world-class scientists. In a recent study, we analysed the international movement and productivity levels of elite research scientists, including Nobel Prize winners and a

data set, which we constructed, of 158 of the world's most highly cited physicists. We draw five conclusions.

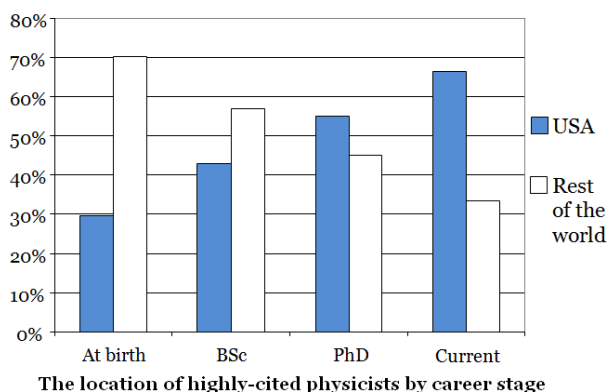
First, the UK currently wins fewer Nobel Prizes in science than it used to, and the United States garners many more. What is less widely known is that in both the

UK and the United States, immigrant scientists win the Nobel Prize less often, proportionately, than in earlier decades.

## Nearly half of the world's most highly cited physicists work outside their country of birth

Second, by charting the careers of a group of distinguished physicists, we show that they are strikingly mobile: nearly half of the world's most highly cited physicists work outside their country of birth. Our 158 physicists were born in 32 countries but now live in only 16. Approximately 30% migrated after their first degrees, and they went predominantly to the United States (see Figure 1).

Figure 1. The funnelling of elite physicists towards the United States



Third, among highly cited physicists, the average productivity (as measured by a citations index called the h-index) of movers is not different from that of stayers. We are unable, with our data, to say whether migration itself causally increases a scholar's productivity, but it might be argued that there are no strong externality effects among senior scholars.

Fourth, international flows of physicists between their first degree and the present day demonstrate that top scholars head to countries with high levels of R&D spending. Switzerland and the United States are the world's large importers, per capita, of elite physicists. CERN, the particle physics laboratory in Switzerland, must play some role here, but because of difficulties caused by multiple affiliations, we have not attempted to separate out those scientists.

Fifth, we find evidence that among elite physicists, a current affiliation in the United States is associated with a 13-19% higher h-index. This may be a genuine productivity difference or reflect some form of pro-US citations bias or some mixture of the two.

## Immigrant scientists in the UK and the United States win the Nobel Prize less often than in earlier decades

How, conceptually, can we make sense of the data? One way to view the findings on physicists is as supporting a theoretical model in which in the modern globalised world, the costs of migration are low. Intuitively, the idea is the following.

Consider a world with very high costs – whether because of cultural differences across societies or costly travel or poor communication – of switching between countries. Then only the very best workers will migrate. This is because they alone are the ones who will make a big enough return from international labour mobility to outweigh the high costs. In this case, migrants will be disproportionately from the top end of the ability distribution. They will be outstanding scientists with, in our terminology, particularly large h-indexes.

Now contrast this with the case of low mobility costs. In that case, elite scientists of more average kinds of abilities, like the norm within the country into which they migrate, will find it rational to choose to switch countries. Hence mobile incoming scientists will be of similar quality to the average of those in the receiving country.

Most of these newcomers will not go on to win science prizes in the way that happened in an older world – think of an early twentieth century setting of ocean liners and telegrams – where mobility costs were high. Any increases through time in the wage premium earned by distinguished scientists in the rich receiving countries will act to reinforce these tendencies.

### Publication details

This article summarises “The Elite Brain Drain” by Rosalind Hunter, Andrew Oswald and Bruce Charlton, published in the *Economic Journal* 119(538) (February 2009): F231-51.

### The authors

Rosalind Hunter and Andrew Oswald are at the University of Warwick. Bruce Charlton is at the University of Newcastle.

## Adapting to the entirely unpredictable: black swans, fat tails, aberrant events, and hubristic models

Since the spring of 2007, economic theorist **Peter Hammond** has been working on a Marie Curie research project called “Adapting to the Entirely Unpredictable.” Here, he comments on some aspects of a well-known book apparently on the same topic – Nassim Nicholas Taleb's *The Black Swan: The Impact of the Highly Improbable*, published in 2007.

In 82 AD, Juvenal wrote of “rara avis in terris nigroque simillima cygno” (a rare bird upon earth, and exceedingly like a black swan), but that was imaginative irony. In the year 1697, Willem de Vlamingh was the first European to record seeing a real live black swan in its native Australian habitat.

Later, John Stuart Mill wrote: “No amount of observations of white swans can allow the inference that all swans are white, but the observation of a single black swan is sufficient to refute that conclusion.” It became a classical example in elementary philosophy.

Taleb's book provides many vivid examples of events, often related to finance or economics, which he sees as meeting his characterisation of a “black swan” event as an “outlier” with “an extreme impact” for which “human

nature makes us concoct explanations after the event.”

The book was written before the recent crisis in global financial markets. Nevertheless, it does discuss several earlier crises, such as the stock market crash of October 1987, which are often plausibly blamed on faulty statistical models.

Indeed, at an early stage of his book, Taleb defines a “special case of ‘gray’ swans,” which are rare but expected. More precisely, they have probability distributions described by “Mandelbrotian randomness,” a particular class of “fat-tailed” probability distribution following a power law.

These distributions put so much weight on outliers, or extreme values of a random variable  $v$  that, for large enough  $k$ , the expectation of the  $k$ th power of  $v$ , otherwise

known as the  $k$ th moment of the distribution, becomes infinite. This is in stark contrast to the normal or Gaussian distribution, for which the tail of the distribution is so “thin” that all moments exist.

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Truly aberrant “black swan” events are those with no probabilities are attached because our models do not even contemplate their possibility

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Yet this is typically not the issue with the random value of an asset, especially a derivative security. For these, there is a positive probability of losing everything. This kind of extreme risk cannot be captured by a Gaussian distribution or by any “smooth” alternative such as a power law.

But there is little really new here, since statisticians and financial economists, along with decision and game theorists, have been coming to terms with probability distributions that do not correspond to a smooth density function.

Much more challenging than these gray swans, however, are the true black swans, which effectively break our existing scientific models. The eponymous example is when Europeans first became aware of the (black) swan species now called *cygnus atratus*, since that broke any of their previous biological models of the genus *cygnus*.

Taleb does recognise that such events could occur, but regards them as “totally intractable,” scientifically speaking. Nevertheless, biologists have formulated statistical models intended to forecast probabilistically the likely number of new species that one might expect to find in a poorly explored habitat. And economists have developed many models of economic growth with technical progress, which may be approximately treated as the accumulation of many small but favourable surprises.

More generally, any practical model, especially in the social sciences, must have bounded scope and so must ignore some real possibilities that could occur and have a noticeable impact. Recent examples include several bank failures and the first UK bank run in over 100 years. So could important new scientific discoveries relating to climate change or its mitigation.

These could be described as “aberrant” events which, by definition, lie outside the current model and the occurrence of which effectively breaks the model. Indeed, aberrant events should be distinguished from events within the model, which, like Taleb’s gray swans, are recognised but given extremely low or even zero probability.

In his classic book *The Foundations of Statistics*, Leonard Savage discusses “small worlds” and contrasts the proverb “cross your bridges as you come to them” with the almost contradictory “look before you leap.”

The first of these recommends a model that temporarily leaves out future bridges, so encountering a river that

cannot be forded becomes an aberrant event. What I like to call “hubristic” models may well do this, and so recommend taking short cuts whose lack of viability becomes clear only as a river bank comes into view. A more cautious route would be along well-marked paths that lead to a useable bridge whenever a significant river is encountered.

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Less “hubristic” modelling could help forestall economic crises or deal better with climate change

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As the statistician George Box wrote: “Essentially, all models are wrong, but some are useful.” Like engineers, it might be wiser to allow some safety margins rather than lurching between successive small-world and insufficiently imaginative hubristic models that never even consider the possibility of an aberrant event.

So while all useful statistical decision models are no doubt incompletely specified, it would be wise to allow for the possibility that they are sure to need serious re-specification at some time, possibly in the near future.

Meanwhile, despite its title, Taleb’s book is mostly about how statistical models, especially in finance, should pay more attention to low-probability gray swans. It would be much more interesting – though undoubtedly challenging – to discuss truly aberrant black swan events, to which no probabilities are attached because the model we use does not even contemplate their possibility.

As for whether less hubristic modelling could help forestall economic crises or deal better with climate change, it seems indisputable that we should at least try. But that is a topic for later discussion.

#### Further details

The full title of Peter Hammond’s Marie Curie research project is “Adapting to the Entirely Unpredictable, and Other Aspects of Dynamic Behaviour: Beyond the von Neumann Standard Paradigm in Games and Economics.” The title alludes to John von Neumann’s pioneering 1928 paper, which offers a “game in extensive form” as a complete mathematical description of many single or multi-person decision problems.

In theory, computers can play chess perfectly; in practice, computers can currently guarantee perfect play only when no more than six pieces remain on the board. Similar limitations apply to all difficult decision problems, including how to model economic and financial systems. So any decision model should be flexible enough to allow graceful adaptation to potential changes that any practical model must otherwise ignore.

#### The author

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## Micro-entrepreneurial success: is capital the answer?

If poor micro-enterprise owners in developing countries get better access to capital, could it raise their incomes significantly? **Christopher Woodruff** and colleagues have explored this question through a field experiment in Sri Lanka, which, among other things, reveals notable differences between male and female micro-entrepreneurs.

A quarter or more of all urban workers in low-income countries are self-employed. The great majority work for their own account, without hiring paid employees. Microfinance has come to be viewed as a “silver bullet” in development, in large part because it provides the capital that enables such self-employed individuals – particularly women – to become micro-entrepreneurs.

But how profitable are investments in micro-enterprises? Will incomes increase substantially if micro-entrepreneurs invest more capital in their enterprises? Our

research set out to answer these questions through an innovative project in Sri Lanka.

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Cash and equipment grants to small firms in Sri Lanka produced high returns to capital

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Measuring the return to capital in micro-enterprises is complicated by unobserved factors, such as entrepreneurial ability and demand shocks, which are likely to be correlated with capital stock. We use a

randomised controlled trial to overcome this problem, providing cash and equipment grants to small firms in Sri Lanka, and measuring the increase in profits arising from this exogenous (positive) shock to their capital stock.

After controlling for possible spillover effects, we find the average real return to capital to be 5.7% per month. This average return is substantially higher than the interest rates charged by micro-lenders, which are around 1-2% per month.

But the experiment reveals a surprising outcome with regard to who benefits most from the capital injection. The grants generated large profit increases for male micro-enterprise owners, but not for female owners. This finding has potentially important implications because most micro-lending organisations target women.

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### The grants generated large profit increases for male owners but not for female owners

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We show that the gender gap does not simply mask differences in ability, risk aversion, entrepreneurial attitudes or reporting behaviour. We do find some evidence that the gender gap is larger in female-dominated industries.

The data suggest that intra-household dynamics have important effects on both the investment decisions and returns earned by women. Bargaining with spouses and other household members appears to be associated with inefficient use of the capital injections by women. The evidence indicates that this inefficiency is reduced in more cooperative households.

#### *Publication details*

This article summarises “Are Women More Credit Constrained? Experimental Evidence on Gender and Microenterprise Returns,” by Suresh de Mel, David McKenzie and Christopher Woodruff, published in the *American Economic Journal – Applied Economics* 1(3) (July 2009): 1-32; and “Returns to Capital in Microenterprises: Evidence from a Field Experiment,” by the same authors, published in the *Quarterly Journal of Economics* 123(4) (November 2008): 1329-1372.

#### *The authors*

Suresh de Mel is at the University of Peradeniya in Sri Lanka. David McKenzie is at the World Bank. Christopher Woodruff is in the Department of Economics at the University of Warwick.

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