Measuring the benefits of University Research: Impact and the REF

Hanan Khazragui and John Hudson,

Abstract

The Research Excellence Framework (REF) is the latest attempt by the UK government to evaluate research in UK universities. A key component of this is the evaluation of the economic and societal impact of research. We evaluate a number of REF case studies and conclude that they are a long way from being an accurate reflection of impact. The science ones tend to focus on revenues raised from spin-out companies and patents, but pay less attention to the wider impact on health, the environment, etc. The non-sciences have difficulties establishing the link between the research and impact. There are also flaws revealed in both the format of the REF structure for evaluating impact and the actual process of evaluation.

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1. Introduction

In the 21\textsuperscript{st} century innovation is of greater importance to the economy and society than at any previous time in our history. In 2012 the world in general, and the EU in particular, stands in risk of an economic downturn from which it may take several years to recover. On top of this we have problems of climate change, and food and resource shortages. Innovation is key to resolving these problems. Universities play a key role in this. The benefits of university research are wide, highly influential and not restricted to innovation per se, particularly when this is narrowly defined. They include bringing new knowledge and perspectives to new and existing businesses and state agencies, introducing highly-skilled graduates equipped with the qualities crucial to having a cutting edge advantage over competitors, improving business strategies, productivity and contributing to policy formulation.

Yet at a time when heavily indebted governments are seeking to reduce spending by any means possible, it is not sufficient to make such claims without providing supporting evidence. This is, in part, why in the UK for the upcoming Research Excellence Framework (REF), evidence of research impact is being introduced as a new component, and academics up and down the country are busy constructing impact case studies, albeit if for many of them somewhat reluctantly. These are to focus on economic and societal impact, forcing them to come to grips with the problem of evaluating their own research in a somewhat unfamiliar way.

In this paper we will analyse the process of assessing economic impact as it relates to the REF. This is trying to identify specific examples of research impact in a case study type approach. We are interested in how academics think about economic impact, as well as how the REF will evaluate it and whether the impact case studies really reflect an accurate impression of impact. The analysis reveals potential problems in the way economic impact has been evaluated and also in establishing the linkages between the underlying research and that economic impact,
particularly for the non-sciences. We argue that ideally impact measures should discount net benefits over both time and space and take into account the full impact, not e.g. just patent revenue. The approach taken in the REF falls far short of that. Almost inevitably perhaps, the measures of impact cited in the case studies are somewhat weak, imprecise and incomplete. In the future, research funders and universities themselves need to systematically collect information on impact, in all of its dimensions, for many years after the initial funding. Even then a ‘first best’ method of evaluating the impact of academic research may simply be out of our reach for some time. Nonetheless, the REF has still performed a valuable function in raising the profile of impact. They also tell a story of strong and diverse impact, albeit one where much of the benefit accrues to foreign multinationals, economies and governments.

The paper proceeds as follows. We first review the literature on impact evaluation. We then discuss in more depth the nature of impact and suggest a methodology to measure impact in an ideal world. This first best approach is then contrasted with the methodologies actually being used in several pilot impact case studies which are available on the REF web site. Finally, we conclude the paper, with suggestions as to how the impact agenda should evolve.

2. Research, Innovation and measuring impact

2.1 Innovation

Until the 1990s the linear model of innovation policy was dominant. This viewed technical change as happening in a linear fashion from invention to innovation to diffusion. The stages of the "Technology Push", version of the original linear model, are: Basic science→Design and engineering→ Manufacturing→ Marketing→ Sales. In this model the role of universities is often fundamental. However, in the past decade a new understanding of the nature of the innovation process has emerged, which emphasizes the systemic and interactive character of innovation (Todtling and Trippl, 2005). This approach argues that innovation should be seen as an evolutionary, non-linear and interactive process, requiring intensive communication and collaboration within companies and between firms and organisations such as universities, financial institutions and government agencies. An example of this is the triple helix model
which emphasises interaction between university, industry and government (Etzkowitz and Leydesdorff, 2000) and a more system-centred approach of innovation policy (Nauwelaers and Wintjes, 2003). This does not mean that focusing on R&D and on the technological aspects of innovation is the wrong policy, but that it needs to be complemented with the organisational, financial, skill and commercial aspects of innovation. Public engagement is also a necessary part of impact (Hudson and Orviska, 2011) and this requires the expertise to efficiently communicate the research outcome to the wider community, which will in turn maximize the breadth and scope of impact.

Whatever model of innovation we focus on it is apparent that research is not innovation. We need the active participation of an innovation partner, someone, whom in some contexts we would call ‘the entrepreneur’, to successfully bring the innovation to market. Failure to do this means that the research, no matter how good will have very little impact. The entrepreneur is critical to private sector innovation, but is equally so to public sector policies and practices, although the persona of the entrepreneur may be slightly different. Nonetheless, the fundamental reality, even in the public sector, remains that without an innovation partner, impact is less likely. In this case one is dependent on contributions to the research commons filtering out to the non-academic community.

In many of the case studies discussed below the entrepreneur was, at least in part, the academic themselves or others in their university, with a university spin-out company promoting the research and bringing it to the market or nearer to the market. However, these spin-out companies still often need outside assistance in the form of venture capitalists to provide them with much of their funding, and often they need the engagement of a larger firm to actually bring the product to the market. But not all research is suitable for spin-out companies. Some requires large firms involvement from the beginning. Hence research may fail because it is not good research, better research elsewhere makes it obsolete, or because there is a failure further down the innovation track to exploit the research and bring it to market (Ekboir, 2003).

2.2 What is economic impact?

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‘Outcome’ is often used to describe a mid-term and intermediate effect, and ‘impact’ a long-term and ultimate effect (CHSRF, 2008, White 2010). Impact typically refers to the final level of the causal chain after the project outcome. This definition of impact is also used by the Australian Technology Network (ATN) (ATN, 2007). Engel-Cox et al. (2008) used a similar approach for developing a conceptual model for research metrics. In their model, impact is imbedded under the outcome umbrella as intermediate to long term outcomes of the research. However, the problem with this is that often impact then relates to research done in the long distant past. Thus of necessity the evaluation of the contribution of research in the recent past must in part rely on outcome together with an extrapolation of outcome into likely impact. In what follows we will use the terms impact and outcome interchangeably, as indeed does the REF itself.

Wolff (2010) defines impact for academic research as “making a demonstrable difference in a non-academic context”. An economic impact exists when it affects the welfare of consumers, the profits of firms or the revenue of government(s). The economic impacts of science and innovation include the resulting contributions to long-term, sustainable economic growth (Romer, 1990) and increased overall welfare. The counterfactual is a critical concept. What would have been the scenario if the research did not exist, subtract that from the situation we have and we have research impact. The scope of economic impacts ranges from those easily quantifiable, in terms of greater wealth, cheaper prices and more revenue, to those less easily quantifiable, such as the effects on public health, the environment, or the quality of life (QOL).

2.3 Impact in the REF

In the REF’s generic guidelines, impact is defined as “an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia.” Examples are given and include effects on, changes or benefits to the activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding of an audience, beneficiary, community, constituency, organisation or individuals. It is not bounded by location and can relate to local, national or international impact. It also emphasises that it includes the reduction or prevention of harm, risk, cost or
other negative effects. But it specifically excludes impact on research or the advancement of academic knowledge within universities and in general impacts on students, teaching or other activities within the submitting university.

There are four separate panels covering different ‘units of assessment’ (UoA). Their guidelines offer examples of impact which vary slightly, but in practice are very wide indeed. For example the Guidelines for Panel B, which relates to the sciences, specifies impacts “that have provided benefits to one or more areas of culture, the economy, the environment, health, public policy and services, quality of life, or society, whether locally, regionally, nationally or internationally”. These go far beyond simple economic impact. 38 Specific examples are given which include: (i) a spin-out business, (ii) stimulating or informing policy debate, (iii) informing policy decisions or changes to legislation, regulations or guidelines, (iv) informing the awareness, attitudes or understanding of (sections of) the public, (v) a new drug, treatment or therapy, diagnostic or medical technology has been developed, trialled with patients, or adopted, (vi) improving the quality of life in a developed or developing country by new products or processes, (vii) changing the management of an environmental risk or hazard and (viii) informing changes to professional standards, guidelines or training. The Guidelines go onto emphasise that all types of impact will be considered equitably in terms of the assessment of the reach and significance achieved during the assessment period.

3. The Literature

The focus is on both measuring the impact of specific projects and the impact of research, or research funding, in its entirety. Traditionally, the success of academic research has been judged in quite narrow ways, usually by an assessment of peer-reviewed published output through bibliometric analysis using citation tracking. Such methods have long been used to assess the efficiency of researchers, projects or programmes, or networks of relations between researchers in similar or overlapping areas of study (Lindsey, 1989; Hicks, 1991). However, there has been a growing tendency in recent years to describe and analyze impact beyond this traditional academic framework. Reflecting this, several national, such as the UK’s Medical Research
Council and the Australian Research Council, and international bodies have articulated analytical frameworks to identify the variables involved in impact assessment and the best metrics to capture them.

There is a tendency for researchers and research funders to overestimate, or at least overstate, the likely short- and medium-term impact of research, in their enthusiasm to justify its importance (SPRU, 2002). In part this is possible because of the challenging nature of the task. There is a consensus in the economics literature (SPRU, 2006) that the challenges arise for a number of reasons. Firstly, research can have direct as well as indirect economic effects. Moreover, as the world is becoming a small nexus of interconnecting research entities it is particularly difficult to attribute domestic economic impacts to only domestic research outcome. Yet if one is attempting to measure or evaluate the impact of the public funding of UK research this is exactly what we must seek to do. Thirdly the time lag between research undertaken and the realization of impact can be variable and often lengthy and the longer the time lag, the more difficult it becomes to trace the impact of the research. For example, a survey of corporate R&D executives showed that an average of 7 years elapsed between a research finding and commercialization, and that commercialization would have been delayed an average of 8 years without academic research. A cost-benefit analysis using this survey data showed a very high social rate of return resulting from academic research. The time lag would affect the discounting process and using a shorter lag time in the discounting process would increase the benefit/cost ratio and the social rate of return. (Kostoff, 1994).

There are different methodologies that have been developed throughout the years to measure economic impact. These range from pure quantitative, pure qualitative and mixed techniques. Quantitative approaches include ones based on econometrics, with an early example being that of Solow et al. (1958). The economic surplus approach pioneered by Griliches (1958) estimates the returns on investment, calculating the change in consumer and producer surpluses that result from technological change brought about through research that causes the industry supply function to shift outwards. The estimated economic surpluses, together with research costs are then used to compute the net present value or internal rate of return. Another approach
pioneered by Evenson (1991), employs a production function, cost function, or total factor productivity analysis to estimate the change in productivity due to research. The estimated research coefficient is then used to derive a marginal rate of return to research investment. A study to estimate the amount of output growth that can be attributed to technological development, led to the conclusion that it could be around 30 to 45% (Stoneman, 1987). This econometric approach may be the only way to get a holistic estimate of research impact, but it faces problems (Maredia et al., 2000) including those caused by a relative lack of data, the interconnected nature of research and the multiplicity of factors which can impact on the dependent variable.

Attempts have also been made to use models that call attention to ‘return on investment’ or ‘research payback’ (Buxton & Hanney, 1996; Hanney et al., 2002; Wooding et al., 2004) which perhaps more closely resemble efforts at evaluating the impact of private sector investment than other measures of impact. Potential impacts were identified as: (i) knowledge production, (ii) research capacity building, (iii) policy or product development and (iv) wider societal benefits from increased population health or productivity. Assessments in each of these categories are derived from multiple data sources, including documentary evidence, surveys and interviews. The data so gathered are sometimes then scored in each category. Such approaches to impact assessment can then provide a profile of scores across each category (sometimes referred to as measures of ‘payback’) and these data can be presented, for example in spider plots, to compare profiles of impacts across projects.

At the other end of the spectrum, there are studies based mostly on qualitative evidence (Yin, 2009). These tend to be focused on specific projects. Case studies offer a detailed view of how and why processes occur, and are useful in evaluating social, cultural, policy and practice impacts, although there is a danger they will focus on successful, rather than unsuccessful, research. Other qualitative methods include expert testimony, longitudinal historical studies, documentary analysis, sociological analysis, Delphi methods and logic models (Boaz et al. 2009; Georghiou et al. 2002; NSF, 2008). Some studies have combined both qualitative and quantitative measure to capture a more thorough analysis of impact. Survey questionnaires can
also underpin the compilation of data for policy impacts. (Boaz et al., 2009) and was also used in Salter and Martin’s (2001) exploration of the channels of the different benefits from basic research.

A study prepared for the ESRC by Molas-Gallart et al. (2000) has developed two forward tracking approaches to assessing impact. The first of these, termed ‘networks and flows’, mapped ‘networks of researchers and relevant non-academic beneficiaries’, before tracing the impacts of these interactions in many and diverse ways with an emphasis on qualitative description. Their second approach (‘post research tracing’) examined the impact of a funded programme of research through the subsequent activities of funded researchers, including their employment outside academe, their consultancy/advisory roles, and the development of further research work. Again this is important. If we are attempting to track the impact of research on the economy and society it needs to be holistic. As another example, if research enhances the reputation of national universities and that attracts students from abroad, that is impact, impact on GDP and on the balance of payments\(^1\).

4. Measuring Impact

4.1 The Basic Equation

Ideally measured, total impact (TI) is the sum of all the net benefits attributable to the research converted into monetary terms, or some other common currency, discounted over time and space:

\[
TI = \sum_{i=1}^{I} \sum_{t=0}^{T} \sum_{s=1}^{S} \alpha_{its} B_{its} d_t d_s
\]  

(1)

\(\alpha_{its}\) is the proportion of the net benefits \((B_{its})\) of usage \(i\), in period \(t\) and location \(s\) which is attributable to the research. \(t\) denotes time, time zero is when the research begins. This relates to a single piece of research which has \(I\) different impacts/uses, e.g. revenue, jobs, health and the

\(^1\) Although it is not recognised as such in the REF.
environment. It is likely that $d_t$, the time discount factor which is often 10% for private investment decisions but much less when used by government to discount social projects, does not differ over spatial location. It is also possible, although perhaps slightly less so, that it does not differ between uses.

It is of course standard to discount over time. But it is less common to discount spatially. $s$ denotes the spatial location of the impact and $S$ the number of such locations. For example we could have, for UK research, different spatial discount rates for (i) the UK, (ii) the EU, (iii) developing countries and (iv) non-EU developed countries. If one is interested in determining impact per se then there is arguably little justification for spatial discounting. But if one is seeking to determine the benefits, e.g., of the public funding of research of UK based institutions, this becomes more relevant. It seems obvious that in this case the maximum impact should relate to the UK rather than some other country. If a firm was to evaluate the rate of return on an investment project, it would not include the increased profits to other firms of its investment, so why should countries? There is little in the literature to guide us on spatial discounting. Arguably GDP impacts on all countries outside the UK should be discounted relative to UK impact. But being as the UK gives aid to developing countries, these may qualify for a smaller discount factor than, e.g., OECD countries. Other aspects of spatial discounting may raise greater problems. For example, would it also be the case that we should discount health or welfare benefits to non-UK citizens in other countries?

There are potentially multiple impacts, denoted by the subscript $i$. For example a new drug may have impacts on the economy and on health. The health impacts depend upon that drug not having been developed, at least at that time. But with drugs it is sometimes the case that other firms too are developing an identical drug and the successful one is the one that wins the patent race. In this case the only gains are to the researchers who hold the patent. If the rival researchers are in another country, then there will be GDP impact, but possibly not a health one for the researcher’s country. Even if rival drugs are not being developed, close substitutes often exist and are being marketed. The health impact then needs to be evaluated on the therapeutic advantage of the developed drug over the alternatives. But this approach too presents problems.
If more than one firm is engaged on research, the net benefit of research needs to take cognisance of the fact that all firms incur research costs. Too often the focus is just on the research costs of ‘the winner’.

4.2 Problems

The problems involved in calculating TI are considerable and vary across disciplines. With respect to \( a_{si} \) in the sciences, where the research has led to a patent then it is reasonable to assume that 100% of the research has led to the patent. There may still be problems if the patent cites other patents or if this was joint research between either different universities or between universities and firms in the private sector. In this case the contribution of specific researchers will need to be evaluated. But research is not impact, the patent is not impact. The research will need to be transformed into impact. In the case of a commercial product, the research needs to be developed to produce a marketable product and the product then needs to be marketed. Sometimes this development involves further research, e.g. what in the pharmaceutical industry is called translational research and in many cases this is not done by the academics. If the patent brings with it royalties and if these royalties were determined in a competitive market, then they are an indication of the research’s worth. Similarly if the patents are sold then this is an indication of their discounted value, provided the sale was done under competitive conditions. For the social and managerial sciences, impact is often impact on a policy decision. In this case deciding impact becomes very difficult. It is rare that a single piece of research has a decisive influence on policy. Rather it is the consequence of a large body of work constituting ‘the commons.’ The seminal work in this literature may have a claim for most impact, but this is often decades old and complemented by multiple other contributions. This is the key problem in evaluating research impact in the non-sciences and is the reason many are currently struggling in the REF.

4.3 Measuring \( B_{it} \)
In principle it is fairly straightforward to obtain an estimate of impact econometrically using time series, or perhaps panel data, relating to a substantial period before the impact event and a slightly shorter time period afterwards. This can be done for sales, costs, deaths, road accidents, pollution, tourism, etc. In the case of a road accident, we then convert this into a monetary value by putting an estimate on (i) the value of human life, (ii) the monetary cost to the authorities, particularly the emergence services, of dealing with the road accident and (iii) the congestion costs to other road users. The main problem with this methodology lies in obtaining the data. Often this never exists in the way we wish, or is infeasible to collect. Even if it does exist, extensive time lags, coupled with the lags in research and transforming research into outcome and then research, inevitably mean we are evaluating research done in the somewhat distant past. In principle the problem is less acute for research which results in a new product marketed by a firm. The firm will know the sales of that product and in principal will thus be able to identify exactly how much the research is worth both in gross and net terms. But outsiders to the firm, even possibly the university IPR holders, may find it impossible to get such data. There may also be problems in estimating the impact net of the counterfactual. If the firm had not introduced that product, then what would have been the alternative and what would that alternative have been worth?

The economic impact of research can be direct, indirect or induced. The impact on the local, regional, and state economies is greater than the total of the research project’s direct spending on goods and services and payroll. This is because of the multiplier, the process by which new jobs generate income which is spent is spent again by the recipient employees and local businesses generating further employment in the local, regional and national economy. It might be argued that this is not research impact. But it is part of the counterfactual and hence needs to be counted and as a consequence, impact does depend upon the multiplier.

5. REF Case Studies
Each unit submitting to the REF will need to provide a number of impact case studies which will be evaluated by expert panels. There are 5 sections: (i) a summary, (ii) a description of the
underpinning research, (iii) the references, (iv) the impact and (v) corroborating evidence for this impact. During 2010 the REF team ran a pilot exercise to test and develop proposals for assessing the impact of research in the REF\(^2\). This involved 29 UK higher education institutions submitting evidence of impact which was assessed by pilot expert panels in the five REF UoA shown in Table 1. The science subjects tend to find it easier to demonstrate impact than the non-science ones. This is particularly the case with the clinical medicine studies which often involve patents. This includes Imperial College’s Thiakis, a spin-out company which has been sold twice, ending up with Pfizer. The underlying research pioneered the use of gut hormones as natural appetite regulators. One particular analogue was developed by Thiakis, and was then evaluated by Pfizer as a potential therapy for obesity. However, there are reports that in 2012 Pfizer has ceased to develop this, with its future now uncertain\(^3\). The second Imperial College case study involving the treatment for rheumatoid arthritis (RA), does not seem to have directly financially benefitted Imperial from IPR revenues, but amongst the funders of this research are listed the pharma firms GSK and Wyeth.

Table 1: The HEFCE Pilot Impact Case Studies

<table>
<thead>
<tr>
<th>University</th>
<th>Case study</th>
<th>Gains</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiff</td>
<td>characterisation of genes</td>
<td>Health, revenue, public engagement.</td>
<td>No attempt is made to quantify the health benefits, even in terms of people affected.</td>
</tr>
<tr>
<td>Exeter &amp; Plymouth</td>
<td>Therapeutic intervention in patients with neonatal diabetes</td>
<td>Health.</td>
<td>The new treatment has been adopted internationally such that more than 400 patients worldwide have had their diabetes therapy changed since 2005. But 400 worldwide does not seem that great an impact</td>
</tr>
<tr>
<td>Glasgow</td>
<td>Smoke-free legislation and hospitalisations for Acute Coronary Syndrome</td>
<td>Public engagement</td>
<td>Evaluated the impact of legislation in Scotland.</td>
</tr>
<tr>
<td>Imperial College</td>
<td>Anti-TNF: a revolution in the treatment of</td>
<td>Revenue, health</td>
<td>Health benefits are not really quantified. Sales of the 3 licensed TNF inhibitors reached $9 billion in 2006.</td>
</tr>
</tbody>
</table>

\(^2\) See http://www.ref.ac.uk/background/pilot/  
\(^3\) http://www.bioworld.com/content/imperial-innovations-regaining-thiakis-obesity-drug-pfizer
<table>
<thead>
<tr>
<th>University</th>
<th>Case study</th>
<th>Gains</th>
<th>Comment</th>
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<tbody>
<tr>
<td>Imperial College</td>
<td>Development of a spin-out company to investigate synthetic oxyntomodulin analogues for obesity therapy</td>
<td>Revenue, potential health</td>
<td>Spin-out firm sold for approximately $30 million with potential additional payments of $120 million. Potential health benefits, as drugs are still being developed, are discussed with some numbers.</td>
</tr>
<tr>
<td>Oxford</td>
<td>Reduction of recurrent stroke risk by early intervention</td>
<td>Revenue, health</td>
<td>Expectation of preventing about 10,000 strokes per year and saving the NHS up to £200 million.</td>
</tr>
<tr>
<td>Physics</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>University</td>
<td>Case study</td>
<td>Gains</td>
<td>Comment</td>
</tr>
<tr>
<td>Cambridge</td>
<td>Teraview and terahertz imaging</td>
<td>Revenue (spin-out company), health, security.</td>
<td>Health and security impacts are only cursorily dealt with.</td>
</tr>
<tr>
<td>Durham</td>
<td>A spin-out company, manufacturing large semiconductor crystals for medical and security imaging.</td>
<td>Revenue (spin-out company), medical, space, security</td>
<td>Non-revenue impacts only cursorily looked at.</td>
</tr>
<tr>
<td>Imperial College</td>
<td>Nanomagnetism and anticounterfeiting</td>
<td>Revenue, employment (spin-out company), industrial and consumer safety and countering criminal and terrorist activity</td>
<td>Non-revenue impacts only cursorily looked at.</td>
</tr>
<tr>
<td>Liverpool John Moores (LJMU)</td>
<td>Spaceport: a tourist attraction based on astronomy</td>
<td>Revenue &amp; local tourist impact, public engagement</td>
<td>Difficult to see how research relates to this.</td>
</tr>
<tr>
<td>Warwick</td>
<td>The consumer electronics industry: The Floating Low-energy Ion Gun.</td>
<td>Revenue</td>
<td>Non-revenue impacts not discussed.</td>
</tr>
<tr>
<td>Earth Systems and Environmental Sciences (ESES)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>Case study</td>
<td>Gains</td>
<td>Comment</td>
</tr>
<tr>
<td>Glasgow</td>
<td>Establishing methods to detect irradiated foods</td>
<td>Consumer safety</td>
<td>Led to new UK and European standards. Little attempt is made to quantify this impact</td>
</tr>
<tr>
<td>Leeds</td>
<td>Turbidites research group consultancy</td>
<td>Revenue and help to oil industry</td>
<td>This is an industry funded consultancy group and it is difficult to separate the research component from the consultancy one.</td>
</tr>
<tr>
<td>Manchester</td>
<td>Spin-out for extensive environmental monitoring</td>
<td>Spin-out company: two products for monitoring water quality in distribution and one for monitoring ground gas. Patents have been applied for and licensed to Siemens</td>
<td>Revenue aspects stressed, although not so much the environmental and QOL benefits. It is not clear which of the research publications feed into this and how.</td>
</tr>
<tr>
<td>Stirling</td>
<td>Conservation of bumblebees</td>
<td>Bumblebee preservation, public engagement, small amount of employment</td>
<td></td>
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<tr>
<td>University</td>
<td>Case study</td>
<td>Gains</td>
<td>Comment</td>
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<tr>
<td>UEA</td>
<td>Compilation of the CRU Global and Hemisphere Land Area Temperature Record and Future Climate Scenario Analysis.</td>
<td>Improved climate change scenarios and UK weather forecasting.</td>
<td>Does not discuss potential secondary impacts.</td>
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</table>

**Social Work and Social Policy (SWSP)**

<table>
<thead>
<tr>
<th>University</th>
<th>Case study</th>
<th>Gains</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leeds</td>
<td>Evidence-based policy: Applications of methodology.</td>
<td>Influenced the “evidence based policy movement”.</td>
<td>This is essentially work done for the commons filtering through to impact on policy evaluation and as such is difficult to evaluate its contribution.</td>
</tr>
<tr>
<td>LSE</td>
<td>Financing long-term care</td>
<td>Better planning for present and future costs and benefits associated with alternative scenarios for social care.</td>
<td></td>
</tr>
<tr>
<td>Ulster</td>
<td>The Review of Public Administration in Northern Ireland</td>
<td>Potential cost savings and The research looked at the origins, implementation and impacts of the review of public impact on working conditions in public sector.</td>
<td>One of the few to emphasise that it will always be difficult to establish a direct cause and effect relationship between research conducted and impacts on public policy.</td>
</tr>
<tr>
<td>York</td>
<td>Child support research and policy impacts (linked to disbanding Child Support Agency).</td>
<td>Public sector cost savings and reduction in personal conflict</td>
<td></td>
</tr>
<tr>
<td>York</td>
<td>The impact of research on child well-being</td>
<td>Improved child well-being and secondary effects such as increased educational attainment</td>
<td></td>
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</tbody>
</table>

**English Language and Literature (ELL)**

<table>
<thead>
<tr>
<th>University</th>
<th>Case study</th>
<th>Gains</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridge</td>
<td>Topography, ecology and culture</td>
<td>Public engagement</td>
<td></td>
</tr>
<tr>
<td>Kingston</td>
<td>Henry VIII at Hampton Court Palace</td>
<td>Tourism revenue, public engagement</td>
<td>Research on Henry VIII’s court has been used to enrich the visitor experience at Hampton Court.</td>
</tr>
<tr>
<td>Lancaster</td>
<td>Literacy research in informing policy-making and improving public services.</td>
<td>Public engagement</td>
<td>Credibly linked to changes in public service practices/guidelines or improved educational attainment among disadvantaged groups</td>
</tr>
<tr>
<td>QMUL</td>
<td>Public understanding of poetry</td>
<td>Public engagement</td>
<td></td>
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<tr>
<td>UCL</td>
<td>Creating educational and commercial access to English</td>
<td>Public engagement, revenue</td>
<td>Research used to build web resources for grammar teaching and learning, specifically, the Internet Grammar of</td>
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The remaining clinical medicine case studies do not relate to the development of new drugs per se, but there are still benefits to the universities and the UK, and they illustrate the diverse aims behind the public funding of university research. Cardiff’s research has facilitated the identification and characterisation of a series of genes for major inherited disorders including autosomal recessive colorectal cancer and Huntington’s disease. New genetic tests which allow earlier and more accurate diagnosis, are now available in the UK and Europe. In North America, Myriad Genetics markets the Colaris AP® testing kit which uses MYH gene technology, generating over £100,000 in royalty income for Cardiff University. At Exeter and Plymouth, research again related to diabetes, whilst Oxford developed simple clinical risk scores to identify patients with a high-risk of a major stroke. Finally, at Glasgow a study researched the evidence that smoke-free legislation has a significant impact on heart disease.

The physics case studies tend to revolve around spin-out companies. The focus is on the employment and income generated. But there are of course other gains to both the economy and society, which are not really discussed in any detail. Take, e.g. Durham’s research on vapour growth of semiconductor compounds. This led to a patented breakthrough in growing large crystals which forms the basis for energy sensitive X-ray detectors and large area substrates for thermal imaging. The process was commercialised by a spin-out company, Kromek Ltd., which employs over 60 people. The company has incorporated this detector technology into medical imaging products and security systems for screening liquids and gels at airports, helping to reduce current restrictions on carry-on baggage and duty free goods. This application won the $400,000 prize in the international Global Security Challenge, and the company currently has a $4M contract to provide large area thermal substrates for the US Defense Threat Reduction Agency. There must also be other health and security benefits, but the case study fails to develop these possibly because of space constraints.

The impact described in ESES is more diverse. Two involve patents, one is linked to improved weather forecasting, another one claims the expertise gained from their research
facilitates their consultancy activities for the oil industry. The benefits are real, but it is a little difficult to specifically tie them to their research as such. Only one of the ELL case studies features patent or spin-out company revenue. The others tend to focus on public engagement impact, although the Kingston one claims core economic benefits in enhancing the quality of a visitor attraction, and hence visitor numbers, and the UCL one reports licensing income. The impact of the SWSP case studies are focused more on policy, although cost savings are also emphasised as is the QOL. But surprisingly perhaps there is little on public engagement. One problem with the SWSP studies is that this research is part of a substantial body of research which will be impacting on the different decision makers. Yet this is seldom emphasised, although Ulster’s case study comments that “it will always be difficult to establish a direct cause and effect relationship between research conducted and impacts on public policy”.

6. Conclusions

Measuring research impact is not an easy task and there is a risk that in focusing on what we can measure, we will ignore what we cannot. But it is necessary for two reasons. Firstly, at a time of economic hardship, research expenditure has to justify itself. But possibly even more important, unless we can measure impact, then it is difficult to maximise that impact and also to allocate public money optimally. The case studies emphasise a relatively simplistic approach to impact in the context of telling a story. The science ones tend to focus on revenue and numbers employed from spin-out companies and licensing, vague references to firms and institutions that have benefitted from the research and generally unquantified health, environment or other benefits. They do not attempt to differentiate between the net impact of the research, with the contribution of impact partners taken out. In addition the case studies seem to imply that if they had not done the research then it would not have been done at all, and hence they claim all the benefits. This may not be too serious if one is attempting to get some rough perception of a university’s research impact in an exercise such as the REF. But if one is trying to make the case to funders that research pays we need something more sophisticated, which discounts both spatially and over time, develops a counterfactual and nets out the research impact from that of
the impact partners. In addition, the case studies do not give an idea of the return to total research funding, as they focus on the successful examples.

To get an overall picture, the funders of research need to track each project over a prolonged period of at least a decade and preferably longer, where the impacts in terms of revenue, patents, output, employment, health, the environment and everything else, including the contribution to the commons need to be recorded under headings which allow spatial and time discounting. At the moment this is not being done, as research funders also illustrate their impact with ‘stories’. Future REFS may also require such holistic information from universities and they would be wise to begin this auditing process now. The case studies have revealed weaknesses both in terms of (i) the impact claimed, which can be both more or less than the full impact and (ii) developing the causal links between research, outcome and impact. The development of causal links is particularly difficult outside the sciences. Yet all of these projects were graded 4*, and presumably will thus be automatically graded 4* in the REF proper. In part this is an inevitable part of the learning process and the REF should be given credit for starting a process. But in part too it is a consequence of having economic impact evaluated by non-economists. If we are serious about assessing economic impact in the REF, then it needs the input of economists.

Measuring impact is a means to an end, rather than an end in itself. It will facilitate the better management of research funds and focus the mind of the academic on impact beyond the academic sphere. But impact does not happen with ‘an invisible hand’, it needs the involvement of others, entrepreneurs and indeed government as in the triple helix model. Research may fail not because of the quality of the research, but because of the lack of involvement of these impact partners. Similarly without the involvement of British, or more widely domestic, firms, then the benefits will be reaped by multinationals. The quality of UK

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4 It is difficult to envisage any other outcome, to rank one of these studies less than 4* would imply both a criticism of the pilot study evaluation and lay the REF process open to claims that it has misled the academic community. Yet this surely gives these impact case studies an unfair advantage over other case studies as well as limiting the panels in the extent they can downgrade and case study for weaknesses which were present in these pilot case studies.
academic research is widely recognised, this is a strength that can be used to a greater extent to strengthen the British economy.

Finally we note that the emphasis on research impact will not go away. It will change after the current REF as lessons are learned, but it will not go away. The time to think about impact is not after the research has finished, but ex-ante before it has even begun. Of course many academics deplore and vilify the whole exercise. There are indeed many potential problems and shortcomings (Smith, et al., 2011). But from our own perspective, if it makes academics think more about maximising the benefits of their research, then that is a good thing. There are lessons here too for both academics and universities in other countries. However, this does not mean we should ignore the value of traditional academic research, research for the commons. Apart from any other considerations, and there are many, that in itself adds to the prestige of an institution and a country and in attracting students to study in that institution or country it too has ‘economic impact’, albeit one not recognised directly by the REF.

References


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