

▶ HIGHER EDUCATION RESEARCH AND DEVELOPMENT: THE COMPLEX UNDERSTANDING OF HUMAN CAPITAL

Countries invest in research and development. They invest in innovation. They create graduate schools dedicated to studying the innovation process and the policy surrounding it. Innovation is created through expenditure on research and development. The gross national expenditure (GERD) is split into sectoral spending; Business Enterprise Expenditure on Research and Development (BERD), Higher Education Expenditure on Research and Development (HERD), Federal Expenditure on Research and Development (FERD), and so on.

BERD is an important focus in governance. Many politicians, economists, and scholars use innovation statistics to evaluate economic health. Analysis of BERD is frequently based on a linear model of innovation, in which outputs are assumed to be proportionate to inputs.

Inputs + Innovation Activities = Outputs → Outcomes

Competitive advantage in industry is an outcome, largely tied to innovation activities. Innovation activities can be defined as the creation, adoption, assimilation, or appropriation of new technologies or processes. In order to capture the most important, difficult-to-capture effects of innovation, total-factor or multi-factor productivity statistics are used. These quantifiable statistics allow relatively simple analysis to be conducted, and a coherent value equation to be constructed. Statistical analysis allows us to understand how BERD investments can be tied to innovative activities, which can be tied to quantifiable outputs and outcomes.

HERD, as a source of R&D, presents a more complicated narrative from inputs to outputs

and outcomes. R&D dollars are invested in higher education. Nation-wide, this investment totals roughly \$7 billion (in comparison to BERD at roughly \$14 billion). While inputs are easily computable, outputs and outcomes are more complex. Some outputs are easily operationalized, and their impact on innovation activities tracked, while others are less clearly defined. The transition to outcomes is even more challenging, as easily quantified outputs do not necessarily translate into a distinct outcome.

Primary outputs of education are commonly acknowledged as publications, citations, and patents. These figures are often used in inter-university comparisons but are infrequently translated into outcomes or economic impacts. Licenses and options created through university research are closer to a quantifiable economic impact. Data is collected by size of industry utilizing the intellectual property, enhancing its utility. However, this metric carries several flaws; research that is licensed accounts for a relatively small part of university research, and innovation stemming from a license accounts for a variable amount of a firm's total productivity. This is also the least comprehensive type of data; thorough data is only available pertaining to the United States. Data collection through local university offices creates significant data inconsistencies. This is a useful statistic, but one that is inconsistent and rarely viable at the national level.

University reputation is a common comparator between both individual institutes and national academic systems, and is an important factor in attracting, developing, and retaining talented researchers. University reputation, according to Times Higher Education, the Shanghai Survey, and the

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Quacquarelli Symonds World University Rankings, includes research output, but also includes wider university operations (i.e. quality of undergraduate education, international outlook, industry income), obscuring the sole impact of HERD. Basic research and graduate student capital are cited as critical outputs of higher education institutes. While the importance of these outputs is rarely disputed, the impact and outcomes tied to these are difficult to compute.

Output markers of higher education research are ultimately a mixed array of outputs and outcomes. Some of these outputs translate into economic impact, while others are only useful in their own terms. Some are interrelated, while others create abstract societal benefit. The measures listed above



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MAKING WAVES



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are the most common and functional outputs and outcomes. The wider literature notes even further abstract metrics; a memorable piece published in 1984 examines the economic benefits of increased education level on categories including social cohesion, child quality through home activities, and “marital choice efficiency”.

The inconsistency of measurable outputs and outcomes raises important questions around the value of HERD. Government evaluation often focuses on those outputs easiest to quantify; publications, licensing, reputation, and number of graduates were used as markers by the Science and Technology Innovation Council (STIC). While these are useful metrics, conducting evaluation according to these quantifiable metrics neglects important venues for innovation, knowledge exchange, and human capital development.

Let us consider the Making Waves blog as a case study. The pieces here would rarely be counted in an H-Index or other publication metrics. Likewise, they will not produce licenses or options. Their impact on university reputation, as it is commonly calculated, is likely minimal. The impact on marital efficiency is, as of yet, indeterminate. Some metrics would say academic venues of this nature produce nothing; a black-hole of HERD expenditure.

However, there are some truly excellent articles on this blog. The pieces are thought pieces, meant to inform the reader about interesting or novel ideas. They offer insight into the thoughts and direction of some of the strongest minds in the country. They offer graduate writers a venue to vet ideas, to test sections of upcoming works and to practice professional writing. They allow the communication of ideas created through decades of experience without the burdens of formal academic publication.

The organization providing this blog, CSIP, has been instrumental to many of my

academic endeavours; I have attended every presentation or conference they have promoted in my graduate school tenure. These have informed my thesis direction, served as excellent networking, and advanced what I hope becomes high-value research. The “Making Waves” site has provided insights into behavioural psychology, nuclear technology, and regulatory structures. The writing of this article has produced applied writing experience from a collection of disjointed thoughts on HERD, and catalyzed several discussions amongst peers about innovation, publication, and epistemology. These are valuable outcomes – outcomes that have side-stepped a distinct quantification of “outputs”.