

“The socioeconomic importance of research based education”

In order to provide effect-based policy guidance, the project seeks to answer: *“What are the societal effects of university-based education in a complex R&D innovation ecosystem, and how might educational policy be improved so as to maximize these effects efficiently?”* Answering such a question is crucial in determining whether recent policy reforms of the Danish educational system have generated or will generate ripple effects on innovation, growth and societal well-being.

In order to answer such an important question, we believe that it is necessary to (1) approach the complex system at several key nodes, (2) use a cross-disciplinary approach that draws on both economics and sociology, (3) employ both micro and macro modeling techniques, and (4) collect and use unique data. To this end, we define five sub-projects. Project 1 (P1) will use a macroeconomic model to estimate the effect of university funding levels on the quality of students. P2 will qualitatively investigate the impact of the private sector on academic research and teaching. P3 and P4 will seek to understand the value that research-based universities provide to individuals and to firms, respectively. P5 will extend the set of sociological-impact models that can be used to understand the R&D-innovation ecosystem.

The project will be led by Anders Sørensen, Copenhagen Business School. Active guidance will be provided by our advisory board: Edward Lazear-Stanford, Kathryn Shaw-Stanford, and Andrew Webster, University of York.

Project 1: Optimal design of funding for university education

Participants: Fane Groes, Copenhagen Business School, Chao Fu, University of Wisconsin-Madison, and Nirav Mehta, Western University

Background and Research Questions: In many countries, there have been substantial increases in university enrollment over time; which have, unfortunately, often been accompanied by longer average time to graduation and lower graduation rates. Output-based funding policies (e.g., the Danish taximeter scheme) try to incentivize universities to improve efficiency in college education. But different universities may have different goals and in response to a given government policy may make different quality-quantity tradeoffs: some may increase their costly inputs (e.g., faculty per student) while others may weaken their standards (e.g., via grade inflation). The central question still unanswered is: *“How do university funding policies affect the quality of research-based teaching, and what is the optimal design of such policies?”*

Methodology: To examine different policies, a structural macroeconomic model is a feasible alternative to implementing costly university reforms. This model seeks to answer the following policy questions:

1. How do different universities operate with respect to choices of inputs, which can, for example, include the number of both external and internal faculty per student and the quality of courses?
2. How do universities compete for students and resources?
3. How would different counterfactual funding policies affect 1 and 2?

Output: Using this structural macro model, we can examine how changing funding from, for example, the taximeter scheme to one that accounts for the outcomes of the student labor market affects the number of university graduates, the length of time until graduation, and the subsequent employment and wages of graduates, as well as the cost of the policy.

Project 2: The role of the private sector in public research institutions

Participants: Jane Vedel, Copenhagen Business School

Research question and background: Typically, studies that seek to understand the determinants of innovation and its subsequent impact on society revolve around an economic model that focuses solely on how public-sector R&D and university education affect innovation in the private sector and how this innovation affects standard economic variables like productivity growth. This unidirectional (“linear”) approach leaves two important questions unanswered: *What impact does the private sector have on academic research and teaching? By which mechanisms does this effect occur?* Our current research has revealed that private companies have a more complex and multidimensional understanding of the value of public research than is generally assumed within public policy. Here we seek to shed light on how academic staff understands the contribution of the private sector.

Method and analysis: The empirical focus of this project is the STEM field. In order to develop a nuanced understanding of the mechanisms by which academics capture and interact with private sector R&D and how this affects their core tasks, qualitative interviews will be used. We will conduct 50 interviews with academic researchers in biomedicine, informatics and engineering. We will code the data using NVivo software and analyze them by focusing on the impact of private funding and private R&D on both academic research agendas and research-based teaching.

Output: This project will develop new insight into the mechanisms by which the private sector stimulates public-sector research and research-based education.

Project 3: Demands and Payoffs for Competencies across University Degrees

Participants: Fane Groes, Copenhagen Business School, Moira Daly, Copenhagen Business School, Nikolaj Harmon, University of Copenhagen, Daniel le Maire, University of Copenhagen, Mathias Fjællegaard Jensen, Copenhagen Business School, and Tróndur Møller Sandoy, Copenhagen Business School.

Background and Research Questions: Although it is widely known that graduates with a major degree in the STEM fields receive some of the highest-paying jobs, surprisingly little is known about the channels through which these higher payoffs occur. Evidence suggests that STEM degrees yield higher payoffs because they train students for specific occupations; but exactly which skills actually yield the high return? This question remains unanswered. Do STEM degrees primarily train students in “specialist” skills whereas degrees in humanities primarily train students in “generalist” skills? Furthermore, do these skills differ depending on whether or not students have graduated from a research-based institution; and, if so, do the payoffs of these skills also differ? We seek to answer: *What are the demands and payoffs of generalist and specialist competencies across different fields of study; and are these affected by whether or not education is attained at a research-based institution?*

Methods and analysis: These questions remain unanswered because of the lack of necessary data. We use new data with all online job openings and their required degrees and competencies. With our data, we can use degree-specific labor markets tightness and the fact that we see the same person in different jobs over time to overcome endogenous selection into a job.

Output: We will describe the demanded competencies across fields of study and estimate the causal effect of possessing generalist or specialist competencies.

Project 4: Research-based education, innovation and firm performance.

Participants: Anders Sørensen, Copenhagen Business School, Moira Daly, Copenhagen Business School, Daniel le Maire, University of Copenhagen, Jeanette Walldorf, Copenhagen Business School.

Research Question and Background: One of the most important determinants of an economy's growth is the rate of technological innovation. In an effort to spur this rate of technological innovation, significant investment is made in universities to encourage research and support the education of the workforce. This model is predicated on the idea that a university-educated workforce—one educated in an institution where research and pedagogy overlap—generates higher rates of innovation and better-quality innovation. Alternatively, investment could be channeled into teaching colleges in which the primary focus is teaching rather than research. Determining which model yields the highest return is an empirical question: Do university graduates, relative to college graduates, contribute more to innovative activity and thus firm performance? Despite the clear importance of this question, it remains unanswered.

Method and analysis: Two types of firms will be considered: (F1) firms that mainly employ university graduates and (F2) firms that mainly employ teaching college graduates. The differences between F1 and F2 firms will be determined along the following margins, controlling for industry and education types: (1) R&D intensity, (2) innovation height, (3) degree of product and service imitation, (4) sales share from new products and services, and (5) degree of university collaboration. Furthermore, the relationship between firm technological efficiency and the marginal productivity of college-educated versus university-educated workers will be investigated. Instrumental variable estimation will be used to deal with issues of endogeneity.

Output: The added value of a university rather than a college education as defined along myriad dimensions will be estimated in order to provide empirical guidance, for the first time in Denmark, to the optimal allocation of funds across the Danish education system.

Project 5: Extending the model of innovation and its impacts: what are the policy implications?

Participants: Jane Vedel, Copenhagen Business School

Research question and background: As discussed in P2, studies that seek to understand the determinants of innovation and its impact on society typically assume an economic model that focuses on how public-sector activity affects innovation in the private sector (the so-called "linear" model) and how this innovation affects standard economic variables like productivity. This is true despite a widespread interest (e.g., in OECD, EU) in expanding the set of metrics used to understand the impact of innovation (i.e., looking beyond just productivity). This project first investigates: (a) *What additional types of economic and non-economic impacts ought to be considered, and how do we measure them?* Next, using the results of P2, we seek to extend the linear model to one in which the private sector also impacts the public sector, a "co-production model", in order to answer: (b) *Does our understanding of these impacts change depending on whether a linear or a co-production model is used; and, if so, what are the effects on optimal policy design?*

Method and analysis: This project is based on two qualitative datasets: (a) an existing dataset that was collected for another project that contains 53 interviews from six private companies, and (b) the dataset to be created as outlined in P2, which will consist of approximately 50 interviews. Those interviews that represent both public and private views on impact will be re-coded/coded using NVivo software. Analysis will focus on a) new economic and non-economic forms of impact and b) optimal policy interventions,

assuming first a linear and then a co-production model, with an emphasis on the degree to which these interventions change according to the model. The analyses will be summarized in two taxonomies, one for each research question.

Output: This analysis will provide necessary empirical evidence on new types of impact and impact mechanisms.