The 2019 Technology Transfer Society Annual Conference
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Session 1.1 – Chair: Al Link
Location – CCF

Title: Deep offshore exploration & production with state-owned oil companies: Comparing Petrobras and Pemex

Authors: Scott McKnight

Presenter: Scott McKnight

Abstract:

Research question

How did Brazil's national oil company (NOC) Petrobras become an award-winning industry leader in deep- and ultra-deep water oil exploration and production (E&P) while Mexico's NOC, Pemex, is a sclerotic laggard?

Common explanations

Traditional explanations fail to explain this stark difference in NOC capacity. After 1945, both Brazil and Mexico experienced state-led industrial 'miracles', which successfully diversified their economies and export bases. Both countries transitioned democracy from the mid-1980s on, and now experience regular elections and changes in control of the presidency. Each country is home to several world-class universities, which each year churn out high-quality engineers, scientists and administrators. Each country boasts a domestic oil industry that date back many decades (Mexico the early 1900s; Brazil to the early 1930s) and feature an abundance of oil reserves (Mexico onshore and offshore; Brazil largely offshore). Likewise, each NOC has decades of experience in every phase of the oil business, after being founded (Pemex in 1938; Petrobras in 1953) with practically no experience and having to learn on-the-spot.[1] Despite all of the similarities, their NOCs are vastly different in capacity, especially in offshore E&P.

Argument

As both Brazil and Mexico approached a crisis in oil self-sufficiency in the late 1960s and early 1970s, each state (a military regime in Brazil; one-party corporatist authoritarianism in Mexico) pushed its vertically integrated NOC to explore for oil in harder-to-reach places. For Mexico, this led Pemex into the jungles of Tabasco-Chiapas and the shallow offshore of the Campeche Sound; for Brazil, into the increasingly deep waters of the Campos Basin. In each then, this particular geological endowment forced the NOC into new areas of E&P expertise. In the case of Petrobras, the state adopted a flexible approach to Petrobras, mixing tax incentives, decision-making autonomy for the NOC, and intense collaborations with

[1] George W. Grayson, *The politics of Mexican oil* (Pittsburgh, Pa: University of Pittsburgh Press, 1980); *Á*ngel de la Vega Navarro, *La evolución del componente petrolero en el desarrollo y la transición de México*, (Programa Universitario de Energ*í*a, Coordinación de Vinculación, Universidad Nacional Autónoma de México, 1999); Isabelle Rousseau, *Tribulaciones de dos empresas petroleras estatales, 1900-2014: trayectorias comparadas de Pemex y PdVSA* (Mexico City: Colégio de México, 2016); On Petrobras, George Philip. 1982. *Oil and Politics in Latin America: Nationalist Movements and State Companies*. New York: Cambridge University Press, pp. 227-42. On the formation of Petrobras, see G. Cohn, *Petroleo e nacionalismo* (Sao Paulo, 1968); Adilson de Oliveira, 'Brazil's Petrobras: strategy and performance', in D. G. Victor et al. (eds.), *Oil and Governance: State-Owned Enterprises and World Energy Supply,* Cambridge University Press, pp. 515-56.

universities (especially through its specialized program known as CENPES).[2] Petrobras emerged an award-winning oil company in deep-water operations, eventually making the historic 'pre-salt' (*pré-sal*) discoveries in the early 2000s in the Santos Basin.[3]

By contrast, Pemex rapidly experienced a bonanza with its finds in the Campeche Sound, deposits that were technologically undemanding and at time of historic high oil prices (late 1970s-early 1980s).[4] After the debt crisis hit Mexico in 1982, the state converted Pemex into a cash-generating machine, systematically decapitalizing the NOC over several decades and allowing its technological arm (the IMP) to atrophy.[5] By the time deep-water oil deposits in the Gulf of Mexico were confirmed through the 2010s, Pemex lacked all capital and expertise to undertake their development, and the state was forced to open the oil monopoly in 2013-14.[6]

Innovation policy in the Brazilian case is one of deep, multi-decade collaboration between Petrobras (especially its E&P division), several Brazilian universities and certain specialized engineering firms. By contrast, in Mexico, Pemex is starved of resources, operational and budgetary autonomy, and the NOC struggles to attract high-quality talent and complex tasks all 'farmed out' to private (invariably foreign) firms.

This research was done as part of my doctoral dissertation in political science on the political economy of national oil companies. As such, I conducted extensive interviews, over 50 in all, with Petrobras and Pemex technical staff, executives, managers, technical staff as well as academics (Brazil, March-April 2018; Mexico, September-October 2017).

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[2] Interviews with various Petrobras engineers, Rio de Janeiro, March 2018; with ex-Petrobras president, Sao Paulo, March 2018. CENPES stands for 'Centro de Pesquisa e Desenvolvimento' or Centre for Research and Development. It proved vital in many of Petrobras's technological breakthroughs. When the Petroleum Law was passed in 1997, a key clause required Petrobras to continue to invest 1% of its budget in R&D, half of which went to CENPES (which roughly covered its budget) while the other half went to academic research for Petrobras projects, which turned into a major stimulus for petroleum-related studies in Brazil. Interview with Brazilian institute research director, Rio de Janeiro, April 2018. On CENPES, see Carlos Eduardo Sarmento and Sergio Lamarao, *Engenharia da Petrobras: 1972-2005,* Petrobras, 2006.

[3] This enormous wealth also made it the focus of a systematic predation scheme, uncovered as the 'Car Wash' (Lava Jato) investigations from late 2014 and continue today. Roberta Paduan, *Petrobras: Uma Historia de Orgulho e Vergonha,* Objetiva, 2016; On the investigations, see Vladimir Netto, *Lava Jato: O Juiz Sergio Moro e Os Bastidores da Operacao que abalou o Brasil* (Primeira Pessoa, 2016); Flavia Pacheco, *Operation Car Wash* (no publisher, 2017).

[4] This rush of wealth also set off a wave of predation of '*telenovela*-levels of corruption'. Interview with Pemex executive, Mexico City, October 2017. Also Michael Gavin, 'The Mexican Oil Boom: 1977-85.' *Working Paper Series* (Inter-American Development Bank, 1996).

[5] Interviews with several IMP (Mexican Petroleum Institute) directors, Mexico City, October 2017.

[6] Juan Carlos Moreno-Brid and Alicia Puyana, 'Mexico's new wave of market reforms,' in P.A. Haslam and P. Heidrich (eds.), *The Political Economy of Natural Resources and Development: From neoliberalism to resource nationalism* (Routledge, 2016).

Title: The role of research funding in African innovation policy

Authors: Leila Tahmooresnejad, Catherine Beaudry

Presenter: Catherine Beaudry

Abstract:

It is only natural to wonder what returns can be seen from research grants and how much these grants improve productivity. While we fully expect research grants to result in an improvement in research productivity, we need to know more specifics. For example, quite often the levels of funding for many scientists are low, while at other times they are not funded at all. A review of funded researchers by Barnett et al. (2015) showed that allocation of large-scale funding is quite random for medical researchers, and many deserving scientists may not capture the attention of potential funding agencies.

However, there have only been a few studies conducted on the effect that grants have on the importance and usefulness of funded research. Given the significance of government investment in health-related research, this necessitates exploring the impact of funding with a special focus on government sources. This article examines the relationship between research funding and the productivity of researchers in Africa. The efficacy of research funding on research productivity holds global significance for all government funding.

In this analysis, we utilize survey data collected via a web-based structured questionnaire for the Global State of Young Scientists precursor study in Africa (GLOSYS). We then match the data with the articles that were extracted from Leiden University's Centre for Science and Technology Studies' (CWTS) in-house database for the publications with those that have at least one author with an African affiliation. The questionnaire was developed in English and French and administered between May 2016 and February 2017.

We contribute to a greater understanding of the relationship between research funding and research output in Africa by utilizing the articles published by funded researchers. These articles have been adjusted for the quality of publications by the number of citations that the articles received and by the normalized journal score of the publications. We determined that research funding had a strong positive effect on knowledge production, suggesting that the allocation of funding to health-related research is extremely effective.

Moreover, in this article, we provide a broad overview of collaboration measures and their impact on research publications and other metrics based on citations and the journal impact factor score. Understanding the impact of these collaboration metrics is increasingly critical for policymakers in light of the focus on improved productivity. When evaluating the collaboration measures, some reviews place a higher value on the number of authors, number of institutes, and the number of countries than others do. While these measures trace a logical path between collaborations and productivity, we include additional collaboration measures using social network analysis for co-authorship networks over time in order to provide more accurate measures on research collaboration.

These network metrics capture a wide range of collaboration activities based on co-authorship links within the network and serve as a beneficial method in demonstrating the impact of collaborations on scientists' published works. We employ network centrality measures to uncover the importance of network characteristics on published papers and their citations.

Title: Public support of technology development in small firms: North Carolina's Matching SBIR/STTR Grant Program

Authors: John Hardin, David Kaiser, Albert N. Link

Presenter: Albert N. Link

Abstract:

The One North Carolina Small Business Program helps fund North Carolina businesses in capital-intensive, high-risk industries in science, technology, engineering and mathematics (STEM) fields of research and technology development. This program, which is one of approximately 20 similar state programs, matches Phase I federal Small Business Innovation Research or Small Business Technology Transfer (SBIR/STTR) grant awards in an effort to encourage innovation and to promote and support scientific, engineering, and industrial research in the State's small businesses.[7]

In late 2017 and early 2018, the Board of Science, Technology and Innovation conducted a comprehensive survey of the 255 small business that received a matching grant over North Carolina fiscal years 2006 through 2017 (July 1, 2005 – June 30, 2017). The purpose of the survey was to measure the program's impacts, evaluate its efficiency and effectiveness in meeting the program's objectives, and collect grantee testimonials regarding the program. Our proposed paper will describe the One North Carolina Small Business Program, discuss broadly the findings from the survey, and present empirical results about the impact of having received a matching Phase I award on the probability that the business received a follow-on Phase II award.[8]

Title: Collaboration in times of connectivity

Authors: Majlinda Zhegu, Ingela Sölvell

Presenter: Majlinda Zhegu

Abstract:

Due to a handful technological innovation whose convergence generates endless technology proposals, we are experiencing the greatest connectivity era. But is connectivity a powerful source of problems or solutions? Connectivity is a technological prowess that despite its great potential of tackling innovative solutions is instead generating huge problems. When not managed carefully, global connectivity is prone of creating more risk rather than enabling the international community to achieve more effectively growth and prosperity goals.

Why greater connectivity does not "spontaneously" help organizational collaborations? Some of the most important obstacles are:

[7] Generally, Phase I awards are for proof of concept; those projects are currently funded at not more than $150,000 for a 6-month period. Successful Phase I awarded firms may apply for Phase II funding.
[8] Those firms that receive funding for a 2-year Phase II project are expected to develop and commercialize an innovative technology. Currently, funding for Phase II awards is generally not more than $1,000,000.

- ***Organizational structure***. The organizational routines tend to hinge most collaboration approaches to the status quo. They naturally slow down or even break any disruption of traditional models of engagement in security-threatening situations. Structural obstacles, as rigid hierarchies, proprietary information or working in silos, prevent the development of "trusted networks of practice" (Brown and Duguit, 2001).

- ***Actors' proximities***. Innovation diffusion theory stipulates proximity as a crucial factor for the adoption of novelty. The concept of proximity has many ramifications based on professional, institutional, geographic, temporal, ethnic, tribal and religious elements. As Tsing (2004) warns, "Global connections are an ever-present reminder that universal claims do not actually make everything everywhere the same". The usual "one-size-fits-all" approach of the international actors creates more friction (and tension) instead of resolving the security threatening situations. Furthermore, if each international actor tries individually to achieve its goal, the overall process risks being a zero-sum game.

- ***Facing wicked problems***. Even in the era of flooding information and great connectivity, many decisions are still made in a context of imperfect information and a good deal of improvisation. Therefore, replacing the work in silos with trusted networks of practice is essential to the decision-making process and improvement of its outcomes.

- ***Technological obstacles.*** Differences (gaps) in the technological tools and IT infrastructure restrain the ability of users to take full advantages form connectivity. In the context of collaboration, technological discrepancies frequently cause interoperability problems.

- ***Legal loopholes***. The accessibility, sharing and diffusion of information in a digital context defy the traditional law doctrines and public regulations. These loopholes seem to prevent the emergence of trusted networks, while questionable (abusive) practices of information access and use are flourishing.

Almost every human activity is facing the challenges of connectivity, which is a keystone of the ongoing digital transformations (Olleros and Zhegu, 2016). Important technological, managerial and social issues are emerging from these transformations. How do the new approaches of co-creation compare to the traditional ways of value creation and value capturing? How do these new forms of collaboration affect traditional balances of organizational power, influence, and authority? How innovation policies are being adapted to the actual high-speed transformations?

This exploratory study combines two complementary perspectives. First, a bird's eye view on the ecology of routines of collaboration: the case of cyber security ecosystems. Second, a worm's eye view on the ecology of routines: the case of Danish Open City Sensor Network. The aim is to corroborate a conceptual framework followed by a large-scale study of the collaboration among the public and private stakeholders involved in the context of digital platforms.

Title: Metrics framework for evaluating technology transfer of federally-funded research

Authors: Vanessa Peña, Christian Dobbins, James Mandelbaum

Presenter: Vanessa Peña

Abstract:

This paper describes (1) the results of a systematic literature review on technology transfer evaluation methods and (2) a framework for measuring and evaluating technology transfer from federally-funded research and development (R&D) based on those findings. Federal technology transfer is broadly defined as the transfer of knowledge and results, such as products, techniques, and tools, from intramural, federally sponsored R&D out of laboratories and into practical application. About two-thirds of the $150 billion in federal funding for R&D supports researchers in non-Federal settings, including universities and the private sector. Thus, Federal technology transfer measures must account for both intramural and extramural transfer activities.

The systematic literature review spans published peer-reviewed articles from the last 10 years—2009 to 2019. We employed a semi-automated method to identify relevant articles through keyword searches and developed relevancy criteria to manually categorize those that empirically analyzed or evaluated technology transfer activities in federal and non-federal contexts. Relevant articles in a federal context included those that analyzed various outcomes, such as patents, licenses and royalties, start-ups, and other economic and workforce benefits, of federally-funded R&D, such as portfolios, programs, or projects. Relevant articles in a non-federal context included those that analyzed similar outcomes, including invention and entrepreneurial ventures; however, with no mention of federally-supported portfolios, programs, or projects.

After reviewing the articles, we categorized measures, metrics, and methods used to analyze technology transfer activities, compared differences between federal and non-federal context studies, and developed a framework that federal policy-makers and managers could reference when considering evaluating the broad impacts of their technology transfer activities. The framework describes common measures that could be employed across varied federal agency mission contexts. We conclude by comparing the framework with existing federal-wide measures and metrics collected and identify options for enhancing federal-wide data collection.