CREATING AND SUSTAINING RESEARCH UNIVERSITIES: POTENTIAL RETURNS AND DEFINITE CHALLENGES

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Abstract

This chapter considers research universities. It focuses on two aspects. First, their potential returns: Why should countries care about setting up and sustaining high-quality research universities? The evidence suggests that university research (and university activity more generally) has *causal* and often *localized* positive impacts on economic and other outcomes. Second, suppose one accepts that university research is worth promoting. What obstacles do university authorities and policymakers face? What approaches and measures might help address these challenges? The discussion focuses on factors like Attracting and ensuring a supply of research talent and measuring research performance.

Keywords: University Research.

JEL classification: I23, I28, O30, O40.

I. INTRODUCTION

This chapter considers research universities. It focuses on two aspects.

First, their potential returns: Why should countries care about setting up and sustaining high-quality research universities? Answering this question is challenging. It requires establishing causal relationships between policies or institutions on the one hand and economic and social outcomes on the other. Despite this difficulty, research on this question has advanced, particularly in recent years. The first section of the chapter briefly summarizes some central studies.

This evidence suggests that university research (and university activity more generally) has *causal* and often *localized* positive impacts on economic and other outcomes. In other words, some countries/regions might be tempted to "free-ride"–to sit back and let others fund research universities producing knowledge that benefits the whole world. Recent work shows this may be a mistake: research universities' positive effects depend on distance. In other words, a country/region can derive disproportionate benefits from research done within its borders.

The chapter reviews the evidence, focusing on studies that arguably establish causal relationships and identify specific channels.[1] Due to this criterion, this evidence is not representative of all countries but focuses on a few cases (*e.g.,* Germany, the U.S., China).

It is worth stating that this evidence does not definitively show that research universities are a high-return investment. But it certainly points to worthwhile positive impacts.

The chapter's second section discusses challenges in setting up and sustaining good research universities. In other words, suppose one accepts that university research is worth promoting. What obstacles do university authorities and policymakers face? What approaches and measures might help address these challenges?

The focus of this discussion is on challenges like:

- Attracting and ensuring a supply of research talent,
- Measuring research performance,

[1] Put otherwise, this chapter does not aim to present an exhaustive review; the text provides further references.

- Securing public funding and popular/political support,
- Understanding and conveying the university's comparative advantage,
- Managing inequality and differentiation across schools,
- Managing inequality in compensation between researchers,
- Generating incentives and rewards for high-quality research, and
- Generating private support.

In discussing these challenges, the chapter directs disproportionate attention to lessons from the U.S. Since this is the approach, two observations are worth explicitly stating. First, the U.S. is relevant because it is widely acknowledged to have the highest quality research universities. Interestingly, that was certainly *not* the case 150 years ago. Thus, understanding what ingredients contributed to its progress is valuable. Second, the U.S. institutional design is *sui generis;* for example, its institutions would be impossible to replicate in much of Europe or Asia. Nevertheless, the U.S. case is helpful because it helps identify what ingredients likely contribute to a robust research university sector. How each country, within its institutional constraints, might put those ingredients in place is a separate question.

II. CREATING AND SUSTAINING RESEARCH UNIVERSITIES: POTENTIAL RETURNS

Prima facie, university research is associated with innovation that promotes economic growth and human welfare. In the sciences, university investigations were central to medical technologies that substantially increased life expectancy, such as X-rays, magnetic resolution, and mRNA vaccines. In the social sciences, university research has helped policymakers mitigate the impacts of financial crises and recessions. University research is also behind technologies used by major corporations, *e.g.,* audio recording by RCA, jet travel by Boeing, algorithms by Google, and positioning systems by Uber (for further discussion see Cole, 2009 and Gruber and Johnson, 2019).

Nevertheless, a careful reader might reasonably question whether such examples conclusively demonstrate that investment in university research is desirable.

First, research universities are expensive. Thus, a country might be tempted to wait for research to happen in the most technologically advanced countries, and benefit as discoveries and their applications disseminate. For example, even high-income and technologically advanced countries, like Japan, made limited investments in a COVID-19 vaccine. This did not stop them from quickly taking advantage of vaccines produced in a handful of countries that had incurred the expense, so they arguably did well.

Second, the examples of research cited above are extreme success stories. Focusing on them may provide a biased picture if a lot of university research lacks impact, particularly given its high cost.

Third, the commercial applications listed are by U.S. corporations. Such success may come only when research output is coupled with other ingredients present in the U.S., like clear property rights, developed capital markets, a large and often relatively unfettered corporate sector, etc.

Such doubts are reasonable, and the available evidence cannot entirely dispel them, certainly not in all settings. Nevertheless, recent work suggests that university research can affect regional and national development. The remainder of this section reviews recent examples. As stated, these are chosen due to the rigor of the evidence rather than attributes like geographical representativeness.

1. Industrial Development in Germany

Dittmar and Meisenzahl (2022) use German microdata to show that before 1800, the development of manufacturing across German cities did not vary with cities' distance to universities. In other words, it does not appear that–in terms of industrial development–a city with a university had any advantage over one without one. They argue that this is not surprising because, over the 1700s, German universities had been focused on theology and law rather than on fields that directly affected industry. Further, for many reasons, at this point, German schools were not the most vital institutions, as evidenced by declining enrollments (see Paulsen, 1906).

This changed in the decades around 1800, with reforms that followed the French Revolution and the Napoleonic invasion. German universities became more science- and research-oriented in ways that could affect manufacturing. For instance, these schools invested in chemistry in ways relevant to the chemical industry; they began to emphasize fields related to engineering, etc. These shifts, along with increased public funding, meant that by the mid-1800s, it

was widely accepted that German universities were world leaders in research. For example, aspiring American academics routinely received their Ph.D. training in schools like Berlin, Göttingen, Heidelberg, etc. (see data in Urquiola [2020] and discussions in Paulsen [1906] and Veysey [1965]).

Dittmar and Meisenzahl argue that this transformation differentially affected cities in a way that had an element of historical accident–cities that, for historical reasons, had universities were more likely to find themselves suddenly endowed with a school doing industry-relevant research. In other words, the setting helps address the concern that industrial growth led to the creation of research universities rather than the other way around.

The paper's key result is that starting in the early 1800s, manufacturing expanded more rapidly in cities near universities. In addition, firms physically closer to universities were more likely to introduce mechanization, particularly in new and more knowledge-intensive industries. They were also more likely to land international prizes for industrial innovation.[2]

In short, this paper suggests that a research university provides a localized, causal benefit. Finally, Dittmar and Meisenzahl argue that these reforms made university-educated inventors more responsive to economic incentives and more likely to act as conduits for technological change. This last point is consistent with research universities contributing to innovation by producing graduates trained at the highest skill levels, a point emphasized in extensive research (Mokyr, 2002 and 2005; Mokyr and Voth, 2010; Squicciarini and Voigtlander, 2015; Bianchi and Giorcelli, 2020).

2. Agricultural Development in the U.S.

While the previous example deals with manufacturing, Kantor and Whalley (2019) consider how university research affects agricultural productivity. They study the effect of funding for agricultural experiment stations at pre-existing U.S. land-grant universities. Their approach relies on studying two pieces of legislation.

First, the U.S. government subsidized higher education through the Morrill Act of 1862, which awarded states the proceeds from the sale of Federal lands. The Act stipulated that the funds were to benefit schools whose activities related to agriculture. There were almost no other conditions; for instance,

[2] The authors implement several robustness checks, *e.g.,* showing that schooling is not a confounder. The effect is also for a period before coal deposits became a driver of industry.

whether the schools had to be public or private. For historical/political reasons, different states awarded their land-grant funds to different types of schools, some pre-existing and some new. Kantor and Whalley (2019) and Moretti (2004) argue that, on average, the pattern was unrelated to locations' future economic development.

Second, Kantor and Whalley consider the Hatch Act, which provided land-grant universities with funding to run agricultural experimentation stations. This allowed them to hire scientists to work on basic research and practical problems (*e.g.,* appropriate crop rotation). On average, these stations conducted effective research, *e.g.,* "notable biological innovations embodied in new crop varieties were achieved quite soon after the stations were established… These innovations are readily apparent in much higher crop yields achieved in station experiments relative to local farmers' productivity …"

The key finding is that although this led to overall gains in agricultural productivity, for about 20 years, the effects were more significant for farms close to the land-grant universities. Over time, such "spatial frictions disappeared as extension programs, automobiles, and telephones made it easier for discoveries to reach farther farms."

In short, the distance to a research university does matter in specific settings and periods. There are reasons to believe this may be particularly the case in agriculture and that the effect dissipated in the U.S. because conditions in broad regions were similar. For example, a corn farm in Indiana might be able to benefit from research on corn production in Illinois–this might be if climatological and soil conditions are similar, for instance (see discussions in Alston *et al.,* 2011).

But across countries, conditions can be quite different. For example, Moscona and Sastry (2022) show that agricultural technology research and development are significantly biased towards the ecological conditions of high-income countries. This is much like commercial drug development being biased toward diseases prevalent in high-income, high-purchasing power countries. Under such conditions, distances of different types will matter, and it may be helpful for countries to sustain their own research universities.

3. Institutional Development in Europe

Another potential impact of research universities, and universities more generally, is a contribution to institutional development. Since institutional strength is largely a country-level trait, here again spatial considerations matter.

Cantoni and Yuchtman (2014) consider the impact of universities during the high Middle Ages when such schools emerged in cities like Bologna and Paris. These centuries set the stage for Europe's transformation from a region that, in many dimensions, trailed parts of China and the Islamic world. They saw Europe attain technological/institutional leadership that allowed it to grow and control/colonize large parts of Africa, America, and Asia. A key innovation during this period was urbanization and the rise of the commercial revolution.

The paper carries out two tasks. First, it presents data on the establishment of about 2,200 German cities, and on when these cities received grants to hold markets and fairs. It presents evidence that these grants are meaningful indicators of expanding economic activity. Second, it asks whether universities had a causal impact on this activity. As usual, the challenge is to argue that the universities contributed to commercial development rather than that commercial development led to the rise of universities.

For analytical leverage, Cantoni and Yuchtman exploit the papal schism that affected the Catholic Church in the 1300s. Historically, popes had been a key source of university charters, and their protection had often been vital to many schools' survival. With the schism, competing popes engaged in further university foundations. This substantially increased Germans' access to university training, as historically, Germany had fewer schools than, say, France or Italy. The authors estimate that German enrollments roughly tripled following the schism.

They also find that establishing universities positively affected commercial activity and that this effect was more significant the closer cities were to emerging universities.[3] In terms of channels, they suggest that part of universities' effect operated through their role in developing legal and administrative knowledge; this helped clarify property rights.

4. Regional Economic Resilience in the U.S.

One question the above studies raise is: when is a university a research university? At what research intensity do effects like the above emerge? Do they only arise when there is a high-end school doing cutting-edge research? Or at more modest research levels?

[3] The paper also implements robustness checks to address the fact that while the schism may have been exogenous, the location of the new universities was not. It also controls for the alignment of different cities with different popes.

Such questions are particularly relevant for middle and low-income countries. For many, the realistic menu does not include setting up a world-leading university. Should they expect any return to investing in university research?

Recent work suggests that there can be positive effects even when considering schools that are not at the very top end of even their country's distribution. As always, to address such questions, researchers must address when given universities arose and where they did.

Howard *et al.* (2022) study the effect of regional universities on local economic resilience. Consider the case of Pittsburgh, once easily among the leading industrial cities in the U.S. In 1910, it was the 8th-largest city in the country and accounted for up to one-half of steel production. It suffered a significant shock, particularly in the 1970s and 80s, as this industry declined. Nevertheless, Pittsburgh's economy proved resilient, and the city diversified into healthcare, finance, and technology (*e.g.,* robotics). It is frequently claimed that Pittsburgh's universities helped it weather the storm. Again, this is a story of a localized effect of university activity.

To explore if there is a causal element to such claims, Howard *et al.* (2022) exploit that in the 1800s, state governments used similar criteria to assign locations for normal schools (*i.e.,* teacher training institutions) and insane asylums. In other words, similar political and economic considerations went into locating state facilities of both types, *e.g.,* both were placed close to population centers and transport networks. The crucial step in their argument is that because of this, counties that received the site for an insane asylum provide a good counterfactual for counties that received a normal school. For example, one might have expected them to have similar future economic trajectories.

However, over the years, asylums and normal schools–although initially of similar sizes–evolved differently. Asylums mainly remained small, state-owned health service facilities. By contrast, many normal schools became regional universities. Such schools, the authors state, "focus on undergraduate and master's level education and are not as research intensive as flagship state universities." In other words, these schools conduct research at a significantly lower intensity than leading state schools.

Howard *et al.* (2022) key result is that such schools make a location more resilient to economic shocks like a decline in manufacturing. For example, counties initially assigned normal schools–relative to counties assigned insane asylums–lose less employment, income, and population following a shock.

This resilience seems to partly arise from the university's resilience–a regional university attracts significant, possibly countercyclical enrollment. Another possible mechanism is that universities increase the local educational level, possibly in ways that help the economy adapt.

5. Universities and Subnational GDP Growth Around the Globe

Valero and Van Reenen (2019) consider related issues –although with less of a focus on research but rather on broad university activity– at the subnational level. They develop a historical database on the location of about 15 thousand universities throughout 78 countries. They find that increases in the number of universities are positively associated with future growth of GDP per capita (an association robust to controlling for a host of observables and unobserved regional trends). Further, Valero and Van Reenen find evidence of positive spillover effects to neighboring regions. They suggest that part of the effect of universities on growth is mediated through an increased supply of human capital and higher levels of innovation. Andersson *et al.* (2004) and Kantor and Whalley (2014) find broadly consistent effects in Sweden and the U.S., respectively.

6. Universities and Local Innovation in the U.S.

Andrews (2023) considers the effect of universities on local innovation in the U.S. He focuses on the decades after 1840, during which many colleges were founded. During this period, localities often competed to become the site of a college. For instance, a religious denomination might express an interest in opening a college, ideally backed up by donors. Towns would then essentially "bid" to become the college site. They might offer land or additional money. To cite an example from an earlier era, Yale College–centuries before it became a large university–operated in Killingworth and Saybrook before moving to New Haven, "whose citizens had outbid all other communities in both land and money to support the college."[4]

Andrews uses narrative information to determine the "runner-up" sites for a set of colleges. The idea is that the runner-up sites provide a useful counterfactual for the sites selected. They were probably similarly organized, had similar access to resources and economic growth prospects, and an equally motivated citizenry, etc.

Andrews shows that, in the long run, establishing a new college causes a substantial increase in local patenting. Specifically, the college counties

[4] "Resources on Yale History: A Brief History of Yale" (guides.library.yale.edu).

have about 60 percent more patents per year than the runner-up counties. Interestingly, most of this effect in patenting is driven not by people affiliated with the college (*e.g.,* faculty members or alumni) but rather by people who moved to the area. This suggests that the college effect may operate through externalities.

7. University Moves in China

The above cases all suggest positive effects of university presence. However, recent work also features at least one instance of a null effect. Liu (2024) studies the moves of universities induced by the Second Sino-Japanese War (1937-1945). During this period, 91 of China's 108 universities were forced to move as Japanese forces advanced. Their moves were generally inland, and their new locations were determined by road networks, building availability, and university leaders' personal connections. While these moves were not random, the analytical hope is that they contain elements unrelated to locations' future economics and educational trajectories.

The main result is that relative to counterfactual locations, those that received a university display some short- to medium-term advantages. For example, they are likelier to have relatively high secondary school enrollment ratios. However, such differences dissipate over time. While this may be due to the setting or to other factors, this study reminds us that while universities may well have positive effects, they are not silver bullets.

8. Summary

The evidence above does not definitively prove that a quality research university would always be a cost-effective investment. However, it does suggest that research universities– and universities more generally –can have a causal impact on outcomes, including economic growth.

This evidence is also consistent with the notions that universities can contribute to innovation by:

- Accelerating patenting in firms and aiding their discoveries (Nelson, 1986; Jaffe, 1989; Mansfield, 1991, and Ahmadpoor and Jones, 2017, and
- Training at a high level (Toivanen and Vaananen, 2016; Aghion *et al.,* 2017),

- More generally, economics emphasizes that such innovation is a crucial source of sustained growth (Solow, 1956; Romer, 1986 and 1990; Aghion and Howitt, 1997, and Galor, 2011).

In short, countries and jurisdictions that seek to set up and sustain research universities may well make a good investment. We now turn to discussing challenges that arise in making that investment successful.

III. CREATING AND SUSTAINING RESEARCH UNIVERSITIES: CHALLENGES

This section reviews challenges that arise in creating and sustaining quality research universities. It features some recommendations in this regard. As noted, the discussion frequently references the U.S. case.[5] The intent is not to imply that the U.S. strategy applies everywhere–far from it. For one, U.S. institutions are, to a significant extent, *sui generis* and difficult to replicate.

Rather, this focus arises because the U.S. was able to create and sustain good universities. In the decades between 1860 and 1930, the U.S. moved from having an academically weak higher education sector to creating the world's leading research universities (Urquiola, 2020). Its trajectory illustrates several ingredients necessary for such a transformation. How different countries produce those ingredients within their institutional frameworks is a complicated question in which local conditions matter. However, highlighting what those ingredients are can be helpful.

1. Attracting and Ensuring a Supply of Talent

Successful research universities must be able to attract talented researchers and, in time, secure a steady supply of them. In this, a university is no different from any other enterprise –like a soccer club or a corporation–that must have the right human resources to prosper. Attracting research talent requires effort and an openness to the outside environment.

Consider how this issue played out in the U.S. Well into the 1800s, American colleges provided almost no specialized or advanced instruction. In this period, a young American who wished to focus on a specific topic, get an advanced

[5] In this, it draws on Urquiola (2020, 2023) and MacLeod and Urquiola (2021).

degree, or prepare for a career featuring research would have immediately considered studying abroad, typically in Germany, England, or France.

Johns Hopkins was the first U.S. school that aspired to make advanced instruction and research a central part of its mission. Its ambition pushed older schools like Harvard and Columbia to compete. All soon found that pursuing these required experts who could be hard to find. For example, early in his presidency of Harvard, around 1872, Charles Eliot observed,

> "There is in this country a considerable body of teachers who know how to teach Latin and Greek, and the elements of language; but if you are in search of teachers to teach botany, chemistry, physics and so on, you cannot find them. They do not exist."

In response to this situation, Daniel Gilman, the first president of Johns Hopkins, began to hire professors trained in Europe, regardless of their citizenship. He hired enough graduates of the University of Göttingen, for example, that some academics nicknamed his school "Gottingen-at-Baltimore" (Flexner, 1946).

This was an essential reform because U.S. colleges had previously been reluctant to hire foreigners or even foreign-trained individuals. Leaders must help their societies resist such impulses if one of their goals is to set up research-oriented schools.

More recently, countries like Chile and China have invested heavily in training their citizens at Ph.D. institutions abroad, to improve their universities. Beyond training, sending faculty abroad exposes a country's researchers to work at the research frontier, and it establishes valuable contacts. To illustrate, Xie and Freeman (2023) document how American training helped advance Chinese science; they state that "the main channel by which China –born scientists collaborated with U.S.-experienced scientists was through the cross-country mobility of China– born researchers to the U.S. … and their return mobility to China …" Such mobility led to higher quality work, as measured by citations and journal quality. Similarly, Ash *et al.* (2024) show that researchers returning to China had positive externalities on their peers' work.

On the other end of these exchanges, the U.S. and other countries received yet another influx of talent from these Chinese migrations, particularly at the graduate student level. This added to repeated academic immigration waves U.S. universities have benefited from.

Similarly, consider the field of economics. While most leading departments are in the U.S., several excellent schools some able to compete with the very best –are in England, France, Spain, Italy, and Mexico. A common denominator of these schools is their willingness to offer instruction in English and, associated with that, their openness to hiring foreign academics. This approach expands the talent pool they can access to include Europe –and U.S.– trained professors.

An open, migration-friendly environment cannot be taken for granted. For an example of how it can fray, consider the present U.S.-China political tensions, which are reducing collaborations and the mobility of researchers and students (Xie and Freeman, 2023). The same is seen in the U.K. and the U.S.: policies that hinder graduate students' ability to study and immigrate, for example, hurt research universities.

2. Measuring Research Performance

Even if the will to hire talent is present, measurement presents an additional challenge. To identify talented researchers –and to decide whether to reward their efforts– one must have access to *measures* of their research output. Have they produced a substantial volume of research? Has their output been of high quality? Here again, looking at the historical U.S. experience is helpful.

As universities like Johns Hopkins attempted to compete with European counterparts, they had difficulty observing research output. Unlike European countries, the U.S. did not have a network of academic journals/ publications that revealed that this or that individual had done good work.

As stated, Daniel Gilman was the first U.S. university president to focus his school on research. He quickly realized that he would have to invest in a measurement infrastructure. Consider the case of mathematics. Math-related European periodicals, like the *Journal de l'Ecole Polytechnique,* appeared in the 1700s. Well into the 1800s, the U.S. had no equivalent outlets. Gilman hired an English mathematician, James Sylvester, who is credited with founding the *American Journal of Mathematics* (1878). Years later, Sylvester disputed that he was the founder, stating:

> "You have spoken of our Mathematical Journal. … Mr. Gilman is continually telling people that I founded it … I assert that he is the founder. Almost the first day I landed in Baltimore, ... he began to plague me to find a Mathematical Journal on this side of the water ... I said it was useless, there were no materials for it. Again and again he returned to the charge and again and again I threw the cold water I could on the scheme; nothing but obstinate persistence … brought his views to prevail" (Flexner, 1946).

With such steps, the U.S. measurement infrastructure grew gradually. On their side, faculty members contributed by creating professional associations, *e.g.,* the American Chemical Society (1877) and the American Historical Association (1884). These began to publish journals that certified research quality via the peer-review process. In time, there also evolved differentiation between journals. Those developing better reputations received more submissions, and their editors made them more selective, thus attracting more papers. The result was a hierarchy of venues by field or sub-field.

Charles Eliot reflected on the impact this had over the course of his long Harvard presidency:

> "The chief difficulty that I encountered was the procuring of teachers competent to give advanced instruction. There were really no guides to the discovery and invitation of the persons needed. Then none of the societies organized for the ... mutual support of learned ... men existed. By 1885 I could get some assistance ... from the proceedings of the ... scientific societies. At the beginning there was no such aid."

Countries around the world face an analogous challenge. On the one hand, there are some advantages now. First, English has become a sort of *lingua franca* for academics. Thus, English-language publications are much more accessible to many academics nowadays than German or French journals were to U.S. researchers in the late 1800s. Thus, it is easier for many countries to leverage the existing global publication network. A complementary investment, of course, is providing English instruction throughout the educational system.

On the other hand, an international publication infrastructure can be a mixed blessing. U.S. journals, for example, have their tastes and agendas, which may not suit every country's issue and policy challenges. So, investment into research venues still matters. Nonetheless, a dense periodical network with a relatively clear quality hierarchy can be very helpful.

Finally, having measures of research quality in place can tempt people to infer research output using those measures mechanically. For example, an evaluation system may become a mechanical function of how many papers a researcher or a school has published in a specific list of domestic and international journals. As is well known, distortions can emerge anytime performance is fixed to a narrow criterion. We return to this issue below.

3. Public Funding

Assuming it is possible to identify talent, one must still be able to attract and retain it. In a broad sense, this requires resources. Providing academics with the conditions they need to engage in research is expensive. Achieving it requires sufficient pay and other costly inputs including:

- Time (time away from teaching and other responsibilities),
- Infrastructure (computers, laboratories, conference venues),
- Research assistants, graduate students, and post-doctoral positions,
- The acquisition of data,
- Field visits,
- Travel, etc.

The bill adds up and tends to increase.

As a result, countries with successful research universities devote substantial public funding to their operation. This does not mean that the private sector cannot be a significant source of support. As discussed below, private contributions are salient drivers of university research in the U.S. But even there, public funding is essential, and the discussion of how to sustain it is central (Gruber and Johnson, 2019).

One fundamental reason is that research is what economists call a public good. The fact that a given person benefits from it does not mean that someone else cannot ("nonrivalry"). For example, consider the mRNA technology –partially developed in universities– used to produce the covid vaccine. The fact that the U.S. or Germany uses the technology does not mean that Kenya or Argentina cannot use it to the benefit of their citizens. As a result, research can have an enormous impact, as a single discovery can benefit millions. But this also means that all kinds of agents, from countries to firms, might prefer to let someone else do the research. If everyone follows that impulse, not enough agents will produce research.

The fact that it is hard to exclude people from the benefits of research ("nonexcludability") aggravates the problem. For example, suppose a university study shows that a particular type of regulation is the best at lowering pollution or that one macroeconomic policy is the best at promoting financial sector

stability. It is hard to exclude anyone from using that knowledge. As a result, research generates benefits that are difficult for institutions to capture or "monetize." For example, many firms will want to pursue research only to the extent that it contributes to profitability. The patenting system helps firms and individuals capture such gains. But it is hard to capture the gains from pure and basic science in that way. The result is that under typical conditions, research will be under-provided by an unfettered market.

In short, as a general principle, adequate funding for research may not emerge absent decisive public intervention. Further, unsubsidized private universities will not be reliable sources of large-scale research. Those institutions will be busy engaging in activities (*e.g.,* teaching) for which it is easier to get people to pay. This is particularly relevant in lower- and middle-income countries where the private university sector has grown the most.

Finally, particularly in advanced, high-income countries, it is worth clarifying when universities have patent rights over intellectual property created using public funding. This can be one factor that helps university-based discoveries impact firms' innovation (Jensen and Thursby, 2001; Hausman, 2022, and Lerner *et al.,* 2024).

4. Political/Popular Support

Since public funding is essential to their progress, one challenge for research universities is to generate the public and political support required to sustain it. This need brings its own set of challenges. Consider two views that have become common in recent years.

First, successful research universities, by definition, have cutting-edge faculty. As a result, they also tend to attract well-prepared students; those individuals will find these schools stimulating and conducive to good skills. The interest is mutual because research-active faculty often view good students as essential to their production process. For instance, graduate students often work with faculty on research. More generally, academics usually prefer to teach well-prepared students. Outstanding preparation, in turn, is usually correlated with students' socioeconomic background. Thus, calling for public funding for research universities typically amounts to calling for funding for schools that, at least to some extent, cater to the wealthy. Some observers further characterize this as a call for funding for repositories of privilege and engines of inequality. These people often call for public resources to go instead toward less exalted institutions reaching broader portions of the population.

Second, in recent years, many observers have concluded that some research universities have been "captured" by progressive, left-wing ideologies or agents that, more than caring about teaching skills or carrying out research, with to impose ideological uniformity.

When one adds the people who see merit in the first position with those who see merit in the second, one can begin to reach sizable coalitions. These coalitions threaten research universities' access to public support and, thus, the sustainability of the research enterprise.

Thus, policymakers and university leaders must make the case that research schools:

- Contribute to the social good; for example, they must articulate the type of rationale covered in Section 1,
- Train an elite useful to public entities, private firms, public health, etc., and
- Work in ways that promote meritocracy and provide access to under-represented groups.

Achieving this is a delicate balance. Suffice it to say that research university admissions processes are a regular target of criticism. For example, the oscillations between the use of admissions exams illustrate the associated challenges.[6]

5. Understanding and Conveying Comparative Advantage

University leaders must also understand and convey to society what their schools' "comparative advantage" is. What can they do better than anyone else? What talent do they recruit? What activities is that talent particularly well suited for? How can they keep the focus on those activities, *i.e.,* "keep their eyes on the ball"?

To illustrate, suppose a successful soccer club recruits talented soccer player. Could one exploit their athletic ability to set up "volleyball training camps" where the team's members coach children or adults on the proper ways of playing volleyball? One could, and presumably, such camps would be popular and importantly, visible: the club would be seen as doing something socially useful. But that could be a misallocation of talent –many people can teach

[6] See Friedman *et al.* (2024) for a discussion. See also Riehl on reforms to standardized tests (2023).

volleyball, and many will be more adept at doing so than a top soccer player. And the players' soccer training will suffer while they engage in this activity.

Similarly, some observers think research university resources should be marshaled to address societal ills directly. Indeed, university leaders seeking to keep their institutions popular –a challenge noted above– can think that the best way to do it is to direct their schools' energy toward ventures with immediate, tangible, and, most of all, visible impacts.

However, the question should always arise: Is that the best use of the talent they are good at identifying and recruiting? It may be that the best contribution a research university can make is to give its professors the freedom to do basic research, as opposed to marshaling them to tackle the most visible "problem of the day." Making such calls can be difficult as they raise tradeoffs and issues that are hard to settle *ex ante.*

6. Inequality and Differentiation Across Schools

Another challenge is that of inequality between schools. Here again, the U.S. setting helps to frame the issue. The U.S. generally gives wide latitude to market forces in its institutional configuration. Its education sector is no exception. For example, any group, whether religious or secular, can relatively easily open a university and attempt to charge high tuition, etc.

Economic theory suggests that such a free-market setting will tend to produce a hierarchy of schools (Spence, 1973; Epple and Romano, 1998, and MacLeod and Urquiola (2015) (see Spence, 1973; Epple and Romano, 1998; MacLeod and Urquiola, 2015). For example, some universities will be incentivized to become selective, as students seek high-ability peer groups or ways to "signal"/transmit their ability to the labor market. As they become more exclusive, such schools can charge higher tuition, fund generous financial aid policies, etc. Those schools will also have incentives to turn away many prospective buyers and to remain small. Not surprisingly, many of these features have emerged in the U.S., just as economic models would predict.

When such patterns prevail, higher-ranked schools will access many more resources than lower-ranked ones. That is the case in the U.S. too. Hoxby (2016) estimates that the most selective American universities spend about fifteen times as much per student as many of their less fortunate counterparts.

Putting this in context, Table 1 presents the per-student expenditure on higher education for the 28 highest-spending OECD countries. The U.S. ranks only behind Luxembourg.

TABLE 1

PER STUDENT EXPENDITURE IN TERTIARY EDUCATION (INCLUSIVE OF RESEARCH EXPENDITURE) OECD COUNTRIES, 2020

Rank	*Country*	*Per student expenditure*	*Rank*	*Country*	*Per student expenditure*
1	Luxembourg	53,421	15	New Zealand	19,567
2	United Stastes	36,172	16	France	18,880
3	United Kingdom	29,534	17	OECD average	18,105
4	Sweden	26,215	18	Estonia	17,930
5	Norway	24,374	19	Slovenia	17,795
6	Canada	24,363	20	Ireland	17,400
7	Denmark	24,432	21	Czech Republic	16,237
8	Belgium	22,555	22	Icelans	16,128
9	Australia	22,204	23	Slovak Republic	14,637
10	Austria	21,753	24	Poland	14,488
11	Netherlands	21,642	25	Spain	14,361
12	Germany	20,760	26	Lithuania	13,629
13	Japan	19,676	27	Latvia	13,043
14	Finland	19,583	28	Italy	12,663

Note: The OECD notes to these data state: "Expenditure in equivalent U.S. dollars converted using PPPs for GDP. Data is based on full-time equivalent students. Data is inclusive of R&D expenditures of those institutions."

Source: Based on OECD data.

Applied to these data, Hoxby's (2016) estimate suggests that the top U.S. research universities spend roughly six times the U.S. average depicted in Table 1–much more than Luxembourg. By contrast, at the bottom end, U.S. schools are spending less than Italy, the lowest-ranked country in Table 1. These numbers are rough, but they convey the type of variation education markets can induce.

Note also that the U.S. inter-school inequality does not only emerge from market forces. Public research funding is allocated to projects as a function of quality, as assessed by expert panels. To the extent that the top universities account for more than their fair share of research talent, it is not surprising that they receive a substantial share of these funds (Graham and Diamond, 1997).[7]

[7] For recent data, see also https://www.nsf.gov/statistics/nsf13325/content.cfm?pub_id=4240&id=2

In the U.S., this inequality likely contributes to research performance. This observation reflects that leading research university performance can come from relatively few schools. In particular, the U.S. has roughly 6,000 higher education institutions, but only about 100 or so –often called "Research 1" institutions– account for the bulk of the country's highest-quality research.

Here, a contrast emerges with Europe, where many states suppress the market forces and the inequality and sorting that characterizes the U.S. university sector. For example, German states and Spanish autonomous communities largely control their university sectors. They often allocate resources in ways that promote equality across schools. It is certainly possible to make the case that this is a good outcome.

However, if the goal is to maximize the quality of research output, it may make sense to allow further differentiation in schools' resources and missions, with a few research universities getting more than a fair share of research talent, funding, and prepared students. To put it bluntly, unless a country/jurisdiction has at least one well-resourced research university, it will be hard to compete at high levels.

Of course, one may think that allowing this type of stratification hurts those students who do not attend elite research-oriented schools. That is not obvious, however. Rigorous research considers the possibility that sorting students into schools of different levels may enhance learning for all, as it allows teachers/schools to target curricula to different levels (Duflo *et al.,* 2011; Machado *et al.,* 2023).[8]

In short, a challenge for a country seeking a quality research university sector is to find a level of differentiation it is willing to allow and to find the public support that will make it sustainable. However, suppressing all differentiation is likely not a way to promote a strong research university sector.

7. Inequality Across Researchers

Attracting and retaining talent requires some tolerance of inequality not just across schools but also across researchers. Return to the emergence of research universities in the U.S. As schools like Chicago or Yale gained the ability to identify research quantity and quality, they began to bid for the best researchers. Chicago, for example, started parts of its faculty by raiding departments at Clark University, taking away talent from a school that had been building a leading research capability but ultimately did not have the funds to compete at the top level.

[8] See also Malamud *et al.* (2024) on how stratification affects non-cognitive outcomes.

Such recruitment processes naturally began to lead to inequality. The U.S., which allows a fair amount of flexibility in pay, naturally accommodated this development. The result was that professors in higher demand got higher salaries, lower teaching, enhanced laboratory space, etc. Decades later this remains the case. At the leading U.S. research universities, academic leaders spend much time deciding on faculty salaries and how to compete with other schools' bids for talent.

The costs of this are well-known, and the resulting inequality is often highlighted as a downside of the U.S. academic career. Specifically, at the top end, American academics are easily among the highest-paid in the world. Conversely, less well-funded schools pay much less or rely on contingent faculty.

Despite the costs of inequality, some high salaries allowed the system to attract talent to research. For example, it allowed a move away from something observed into the 1800s, where it was more likely that only independently wealthy academics might be able to devote themselves to research.

Allowing inequality between researchers poses a challenge in many countries. For example, in parts of Europe, faculty pay is relatively rigid–approximately a mechanical function of seniority and rank. While this has obvious advantages such as transparency, it also makes selecting and rewarding faculty hard. To the extent that it limits salaries at the top, it also makes attracting talent difficult. This is particularly true because as stated, top researchers can be mobile across countries. Indeed, one reason the U.S. research universities do so well is that they compete in a global market where other institutions enjoy less flexibility.

8. Incentives for Quality Research[9]

The above sections dwell on research talent and financial resources. Both ingredients are essential to obtaining high-quality research output. Another critical element is effort: success also requires that academics be willing to work very hard.

To some extent, if professors are selected well, this takes care of itself. Many faculty members are intrinsically motivated–they love research and would be willing to do it for little pay. However, policy cannot rely on that alone, incentives matter.

[9] This discussion draws on MacLeod and Urquiola (2021).

As a result, it is good to have rewards for research performance. The existence of a market –and the ability of top schools to pay better researchers more– significantly moves things in this direction. Even in countries that restrict pay inequality, "real pay" can be used to vary rewards. For example, two European chair-holders may make the same nominal salary, but one might be given resources to lead a more prominent institute, have access to better space and more post-doctoral positions, etc. Effectively, they are paid differently, and if set accordingly, their pay can reflect their research productivity.

However, pay alone is insufficient, and inequality arising from school competition is a coarse way of tailoring rewards to research performance. For example, if pay can only be adjusted when an individual moves or receives an offer to do so, it may imperfectly reflect productivity. To illustrate, some productive researchers may be unable to move due to family reasons. If prospective employers realize this, they will extend fewer offers, and their salaries might reflect their productivity with only long lags.

In some countries, universities adjust for this by granting bonuses for publications in specific journals as a function of these outlets' prestige, "impact factor," etc. This can undoubtedly incentivize output, but it can also distort incentives. For example, a researcher might choose to publish many articles in lower-ranked journals if she finds that more financially rewarding than spending a lot of time investing in a more fundamental contribution. For example, a common concern about universities in East Asia is that while the quantity of research produced has dramatically increased, the quality still needs improvement (see Ito *et al.,* 2023 and discussion in that volume).

In short, a key question is how to incentivize effort in ways that direct researchers to maximize quality and do not purely rely on pay. There is no unique way of doing this; coming up with one is another relevant challenge.

In the U.S., the tenure system is one way to address this challenge. The decades in which the U.S. emerged as a leader in university research also saw the emergence of tenure, a salient reward for research performance.

The central feature of tenure is a fixed-term trial period followed by an "up or out" decision. A junior professor at a top U.S. university will be given 6-8 years to produce a collection of research that goes into a tenure "dossier." This file is thoroughly evaluated in a process that takes months and involves reports from multiple committees and input from ten or more experts at other schools.

At the top schools, the question posed to committees and outside referees is not whether the candidate published enough papers in specific journals –the

question is not about counting papers. The question is whether the package and its impact are high-quality enough to warrant classifying the candidate as an intellectual leader or a creative individual. This flexibility prevents the type of gaming that naturally arises when the criterion is simply mechanical.

If the candidate is judged to have achieved enough, he/she receives tenure and all but guaranteed employment without a retirement age. If not, the candidate is given a fixed time to find another position.[10] On average, junior professors respond to this scheme by exerting high effort.[11]

However, such a response is only rational if candidates believe they are reasonably likely to get tenure. If there is a lot of variation in ability, then some individuals will have a very low or high probability of getting tenure, and for them, the scheme will have little effect. This implies that tenure will more effectively promote effort if combined with a process whereby professors sort into schools according to their research ability (MacLeod and Urquiola, 2021). This is precisely the type of sorting delivered when schools can compete for the best researchers. In other words, the top departments in the country have, on average, the best researchers, and they are of roughly similar abilities. The second-ranked department may be just below, and so forth. In such a setting, tenure will have effects throughout the distribution.[12]

Tenure is not the only way to provide incentives. For example, the European Union has implemented large grants targeted at researchers in different career stages. They are allocated based on the quality of researchers' proposals and their records as captured in their CVs. That scheme has advantages and disadvantages relative to tenure, but it is another way to mark high-stakes moments when people examine the quality of work.

9. Private Support

Funding research universities is expensive; thus, any help from the private sector can make a substantial difference. A key challenge is how to mobilize it.

[10] In recent decades, tenure has become less common in the U.S., and it is increasingly available only to research-focused professors at wealthier universities (Figlio *et al.,* 2015).

[11] Note that, unlike a salary, tenure is a discrete prize given for reaching a threshold level of achievement or relative performance–it does not allow for minor enhancements. For applications of economic theory to this type of contract see Lazear and Rosen (1981), Carmichael (1983), and Malcomson (1984) and MacLeod and Urquiola (2021).

[12] Like many features of the U.S. system, tenure emerged in a decentralized fashion. The way in which it interacts with other system features was not part of a centralized design.

One option is to allow schools flexibility in setting their tuition. Such flexibility is undoubtedly available in the U.S., where annual tuition (not including living expenses) at the leading private research universities exceeds 60 thousand dollars. Despite such prices, American and foreign citizens are eager to enroll. These schools' ability to charge such high prices *could* reflect that they provide outstanding skills, valuable networks, and good job placements. But it could also exist absent such advantages if families simply like to "consume" the prestige associated with such selective environments.

Notably, U.S. states generally allow similar flexibility in their public research universities. For example, while the University of Michigan charges about 18 thousand dollars in tuition to in-state students, its out-of-state charges, at just under 60 thousand, are like those at top private universities. The corresponding figures at the University of California at Berkeley are in the same realm, if a bit lower (about 15 and 45 thousand, respectively). This should not be shocking, given that Berkeley and Michigan –among several other public universities in the U.S.– compete at the highest level. They could not do so without this type of private support, which, in some cases (*e.g.,* that of Berkeley), is a large part of their budget.

Of course, U.S. universities do particularly well in one additional dimension of private support: donations given outright rather than in exchange for instructional services. Their model is one in which students develop an enduring loyalty to their schools and become invested in their reputation and future. The evidence suggests at least part of their support stems from the desire to raise the probability of admission for their children.[13] However, part of it is genuine loyalty and a desire to be affiliated with prestigious institutions that positively impact the world.

The role of private support in the U.S. might seem so extreme as to be irrelevant to most other countries. It is worth mentioning that the fundamental practices it displays did not originate in the U.S. The original tuition-funded universities emerged in cities in France and Italy. The original donations to colleges originated in England and France, in many cases animated by donors who secured special treatment for sons and nephews (or people from their home regions). For example, the *Collège de Sorbonne* (Paris) was founded with a donation by Robert de Sorbon, and Merton College (Oxford) by Walter de Merton. The U.S. coupled these ideas with a *laissez-faire* educational market orientation that amplified them, but it did not invent them.

[13] Meer and Rosen (2009) suggest that roughly half of giving my alumni at one selective private university is driven by hope of reciprocity for their children.

Significantly, the U.S. also augmented them with public support because donations are tax-deductible (tax deductibility applies to schools and many charitable institutions). Thus, private support in the U.S. does not exist in a vacuum; it receives strong support from public policy. The bottom line is that there are measures countries can take to increase private support for universities.

A system that mobilizes private support can take decades to build, but efforts can provide some short to medium-term returns. For example, in recent years a handful of private Latin American universities have cultivated alumni and wealthy families in ways that cover non-trivial portions of their capital investment and financial aid budgets.

IV. CONCLUSION

Casual observation suggests that research universities can substantially contribute to economic growth and human welfare. In a way, that is not shocking, as universities are part of the research ecosystem, and economists believe that, in the long run, pure and applied research/innovation are the central source of sustainable growth.

Nevertheless, while research universities' positive impact may be plausible, whether it is causal is ultimately an empirical question. Increasing evidence suggests that research universities have a real positive impact and that this effect is somewhat localized. In short, the evidence indicates potential returns to investing in and sustaining a quality research university sector.

Nonetheless, doing so immediately raises challenges. A research university sector is unlikely to develop naturally; its formation and continued health require government authorities' and university leaders' deliberate attention and work. This raises several tradeoffs that are hard to navigate. They are concerned with issues including communication, funding, access for under-represented groups, and inequality. Each country or jurisdiction must address these within its institutional and political constraints. The U.S. developed the leading research universities because it developed ways to address these challenges, particularly over a few decades in the late 1800s.

More generally, universities are one of the more enduring forms of human organization. Having arisen spontaneously, they have existed for about 800 years. While they were always concerned with instruction, research gradually became one of their central activities and one reason they garnered interest

and support. Keeping this part of the endeavor going is an important challenge for policymakers and university leaders.

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