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The Globalization of the Bayh–Dole Act

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The Globalization of the Bayh–Dole Act

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ABSTRACT

Our thesis in this monograph is that an overlooked metric associated with the impact of the Bayh–Dole Act is its effect on influencing university-based technology transfer policies in other countries. We refer to this phenomenon by the phrase The Globalization of the Bayh–Dole Act. To substantiate this thesis, Bayh–Dole like university technology transfer policies in 20 other countries are reviewed. In an effort toward an assessment of these Bayh–Dole like policies, we explore in each country higher education expenditures on research and development (R&D) before and after the Bayh–Dole like policies were adopted. We conclude, in terms of this metric, that in some countries the Bayh–Dole like policies have been more effective than in others.

Keywords: Bayh–Dole Act; technology transfer; policy evaluation; R&D.
Possibly the most inspired piece of legislation to be enacted in American over the past half-century was the Bayh–Dole Act of 1980

—The Economist

1.1 Setting the Stage

On December 12, 1980, President Jimmy Carter signed Public Law 96-517, Amendments to the Patent and Trademark Laws Act.\(^1\) This act is formally known as the University and Small Business Patent Procedure Act of 1980, and it is informally or commonly known as the Bayh–Dole Act of 1980.

The legislative process which led to the passage of the Bayh–Dole Act began on March 26, 1980 as H.R. 6933.\(^2\) The Act was introduced in the aftermath of productivity slowdowns in various sectors of the U.S. economy. The Economist, from which the epigraph above came, referred


to this period of time before the passage of the Act as the period of “technological malaise that befell America in the late 1970s.”

Figure 1.1 illustrates the Multifactor Productivity (MFP) index for the years 1965 through 1985 for the Private Business Sector in the United States.\(^3\) MFP, or as many economists refer to it as total factor productivity (TFP), is widely regarded as an index of technological advancement.\(^4\) This figure clearly shows the decline in MFP in the early 1970s and then again in the late 1970s and early 1980s.\(^5\)

Figure 1.2 shows, over the same time period of 1965 through 1985, the annual percentage change in MFP for the private business sector. Figure 1.3 shows, over the same time period, the MFP index for the non-farm business sector.\(^6\) And, Figure 1.4 shows, again over the same time period, the annual percentage change in MFP for the non-farm business sector. Figures 1.1 through 1.4 tell the same story; technological advancement slowed in the United States in the early 1970s and then again in the late 1970s and early 1980s. It was these periods of productivity slowdown or “technological malaise” that initiated several new and responsive technology policies in the United States. That policy story began during the Administration of President Jimmy Carter.

President Jimmy Carter’s policy prescriptions for reversing this productivity decline were set forth, at least in part, in what has become

\(^3\)Publications related to the documentation of the measurement of multifactor productivity by the U.S. Bureau of Labor Statistics is at: https://www.bls.gov/mfp/home.htm#technotes.

\(^4\)This interpretation of TFP arguably dates to Solow (1957).

\(^5\)These are the periods of decline referred to in The Economist article as “technological malaise.” An excellent academic history of the Bayh–Dole Act is in Stevens (2004).

\(^6\)The private business sector of the United States is a subset of the U.S. domestic economy and it excludes the economic activities of the following: general government, private households, and nonprofit organizations serving individuals. The non-farm business sector is a subset of the U.S. domestic economy and excludes the economic activities of the following: general government, private households, nonprofit organizations serving individuals, and farms. The two pairs of figures are almost identical as might be expected because the farm sector is relatively small. See: https://www.bls.gov/bls/glossary.htm#B.
Figure 1.1: Annual multifactor productivity index for the private business sector in the United States, 1965–1985 (2012 = 100).


Figure 1.2: Annual multifactor productivity percentage change for the private business sector in the United States, 1965–1985.


known as his Domestic Policy Review (1979). Therein the President’s remarks are:

I will also support the retention of patent ownership by small business and universities [our emphasis added], the prime thrust of legislation now in Congress, in recognition of their special place in our society.

---

7 James (Jimmy) Earl Carter Jr. served as the 39th president of the United States from 1977 to 1981.
1.1. Setting the Stage

Figure 1.3: Annual multifactor productivity index for the non-farm business sector in the United States, 1965–1985 (2012 = 100).


Figure 1.4: Annual multifactor productivity percentage change for the non-farm business sector in the United States, 1965–1985.


The Bayh–Dole Act, with our emphasis again added in italics, states:

It is the policy and objective of the Congress to use the patent system to promote the utilization of inventions arising from federally supported research or development; to encourage maximum participation of small business firms in federally supported research and development efforts; to promote collaboration between commercial concerns and nonprofit organizations, including universities; to ensure
that inventions made by nonprofit organizations and small business firms are used in a manner to promote free competition and enterprise; to promote the commercialization and public availability of inventions made in the United States by United States industry and labor; to ensure that the Government obtains sufficient rights in federally supported inventions to meet the needs of the Government and protect the public against nonuse or unreasonable use of inventions; and to minimize the costs of administering policies in this area.

The Bayh–Dole Act was one of several reasoned policy responses to the productivity slowdown that plagued the private sector of the United States. Again, this productivity slowdown was what The Economist article had referred to as the period of U.S. “technological malaise.”

As the title of this monograph suggests, the Bayh–Dole Act has been embraced (i.e., imitated) globally. This apparent influence of the Act raises questions about how one should view the Act. Specifically: Was the Bayh–Dole Act simply a timely piece of legislation that serendipitously captured global attention at a time when productivity growth was slowing down in many industrialized nations? Or: Was the Act something else? Did the Bayh–Dole Act represent a new way of viewing technology

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Although the focus of this monograph is on the Bayh–Dole Act, we would be remiss if we did not also mention other U.S. technology policies that were and were not mentioned in President Carter’s Domestic Policy Review. These included the Stevenson-Wydler Act of 1980, the R&E tax credit of 1981, the Small Business Innovation Development Act of 1982, and the National Cooperative Research Act of 1984. Clearly, using national data, it would be difficulty to isolate the impact of any one particular legislative initiative on a measure of technological advancement. Thus, Bozeman and Link (2015) examined the ratio of R&D investments to value added in the United States over the period 1953 through 2011. Their estimate of statistical fixed effects policy models (2014, pp. 373–374): “suggest that the technology and innovation policies under study in this monograph—and these are the policies that shaped the post productivity slowdown legislative response—did indeed have a measurable impact on the relative level of industrial investments in R&D, but that impact has waned.”
policy—that is, a new lens through which to view technology policy—within the United States and in other countries?\(^9\)

Leyden and Link (2015) and Hayter et al. (2019) have offered such a new lens through which to view not only the Bayh–Dole Act of 1980 but also the other technology policies that were promulgated in the United States in the early 1980s. Perhaps this public sector entrepreneurship lens has a broader appeal to understanding the adoption of technology policy initiatives than simply saying that a country imitated a particular U.S. technology policy initiative.\(^{10}\)

Many scholars have offered definitions about who an entrepreneur is and what he/she does. Accordingly, a so-called entrepreneurial lens merits a definition, from a public sector perspective, of what makes such a lens or perspective entrepreneurial.\(^{11}\)

### 1.2 A Public Sector Entrepreneurship Lens

Leyden and Link (2015, p. 46) define the concept of public sector entrepreneurship in the following way:\(^{12}\)

> Public sector entrepreneurship . . . refers to innovative public policy initiatives that generate greater economic prosperity by transforming a status quo economic environment into

\(^9\)It should not go unnoticed that the first formal U.S. technology policy statement is dated as 1990: *U.S. Technology Policy* (Executive Office of the President, Office of Science and Technology Policy, 1990). Some might take issue with our claim that this is the first formal technology statement, and they might argue that Bush’s *Science—the Endless Frontier* (1945) is the foundation for U.S. technology policy. There are clearly elements of *Endless Frontier* in *U.S. Technology Policy*, as Leyden and Link (2015) point out, and those elements can meaningfully be characterized as having aspects of public sector entrepreneurial intensions.

\(^{10}\)For examples, see Hayter et al. (2019). They make the argument that the entrepreneurial lens is also applicable for viewing the genesis of and consequences from global grand challenge programs.

\(^{11}\)See, Hébert and Link (2006, 2009) for an intellectual history of the concept of entrepreneurship.

\(^{12}\)Subsequently, Hayter et al. (2019, p. 682) modify this definition of public sector entrepreneurship as: “Public-sector entrepreneurship refers to the formation of innovative public-sector initiatives that transform a status quo social and economic environment into one that is more conducive to creative change in the face of uncertainty.”
Table 1.1: Dimensions of the Bayh–Dole Act as an example of public sector entrepreneurship

<table>
<thead>
<tr>
<th>Initiating party of the Act</th>
<th>U.S. Congress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targeted party of the Act</td>
<td>Universities and private sector firms</td>
</tr>
<tr>
<td>Direct versus indirect nature of the Act</td>
<td>Indirect option to universities; effects are indirect based on research success</td>
</tr>
<tr>
<td>Innovative nature of the Act</td>
<td>Transferring technology from universities creates new production possibilities for firms</td>
</tr>
<tr>
<td>Status quo economic environment transformed by the Act</td>
<td>Advancement of knowledge within firms, which enhances economic growth.</td>
</tr>
<tr>
<td>Dimensions of uncertainty</td>
<td>Adopting technology from universities is outside of the routine and thus has uncertain outcomes</td>
</tr>
</tbody>
</table>

Source: Based on Hayter et al. (2019).

Leyden and Link (2015) go on to make a case that the passage of the Bayh–Dole Act is an example of public sector entrepreneurship. The Act redirects property rights that brings about the transfer of existing knowledge from a university to the private sector for commercial exploitation. Hayter et al. (2019) elaborate on the fact that the Bayh–Dole Act is an example of public sector entrepreneurship by characterizing the Act through various entrepreneurial dimensions as we have summarized in Table 1.1.

One aspect of the Leyden and Link (2015) definition of the concept of public sector entrepreneurship as a lens through which to view public policies to be emphasized in the case of the Bayh–Dole Act is their phrase “engaging in creative activities in the face of uncertainty.” As shown in Table 1.2, data from the European Commission show that, even at the time of the publication of these data in 2017, many universities

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13 The relevant literature on public sector entrepreneurship is reviewed in Leyden and Link (2015), and that review is expanded in Hayter et al. (2019).
1.2. A Public Sector Entrepreneurship Lens

Table 1.2: Industry collaboration with universities in the area of university R&D results (selected countries)

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent of University and Higher Education Institution Representatives Responding “Not at All”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain (1983)</td>
<td>83.1</td>
</tr>
<tr>
<td>United Kingdom (1985)</td>
<td>80.2</td>
</tr>
<tr>
<td>Denmark (1999)</td>
<td>70.2</td>
</tr>
<tr>
<td>France (1999)</td>
<td>78.9</td>
</tr>
<tr>
<td>Italy (2001)</td>
<td>90.1</td>
</tr>
<tr>
<td>Austria (2002)</td>
<td>48.4</td>
</tr>
<tr>
<td>Germany (2002)</td>
<td>56.4</td>
</tr>
<tr>
<td>Norway (2003)</td>
<td>80.3</td>
</tr>
<tr>
<td>Finland (2007)</td>
<td>66.4</td>
</tr>
</tbody>
</table>


Note: The year that a country adopted a Bayh–Dole like university technology policy is shown in parentheses. This table includes all of the countries that adopted a Bayh–Dole like policy that are described in the European Commission (2017) report.

Infrequently collaborate with industry in the commercialization of their R&D results, where collaboration refers to licensing activity or patenting activity.

As will be discussed below, Spain was the first country to adopt a Bayh–Dole like university technology policy, and that occurred in 1983. As of the European Commission’s (2017) publication, 83.1 percent of the Spanish academic and higher education institution (HEI) representatives surveyed by the Commission responded that they have no [our emphasis] such collaboration with industry. Austria, at the other end of the distribution with the highest collaboration rate among the countries surveyed, is characterized by 48.4 percent of the respondents having no licensing or patenting activity collaboration with industry. Austria adopted a Bayh–Dole like university technology policy in 2007, as we will also discuss below.

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Table 1.3: Percentage of firms reporting partners with which they co-operate in innovation, 2014 (selected countries)

<table>
<thead>
<tr>
<th>Country</th>
<th>Universities or Other Higher Education Institutions</th>
<th>Government or Public Research Institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain (1983)</td>
<td>7.3</td>
<td>9.7</td>
</tr>
<tr>
<td>United Kingdom (1985)</td>
<td>4.7</td>
<td>2.5</td>
</tr>
<tr>
<td>China (1994)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Denmark (1999)</td>
<td>14.5</td>
<td>10.5</td>
</tr>
<tr>
<td>France (1999)</td>
<td>13.2</td>
<td>10.8</td>
</tr>
<tr>
<td>Japan (1999)</td>
<td>15.7</td>
<td>14.4</td>
</tr>
<tr>
<td>South Korea (2000)</td>
<td>10.0</td>
<td>12.8</td>
</tr>
<tr>
<td>Italy (2001)</td>
<td>5.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Austria (2002)</td>
<td>24.7</td>
<td>11.6</td>
</tr>
<tr>
<td>Germany (2002)</td>
<td>17.1</td>
<td>8.1</td>
</tr>
<tr>
<td>Indonesia (2002)</td>
<td>8.4</td>
<td>4.9</td>
</tr>
<tr>
<td>Mexico (2002)</td>
<td>7.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Norway (2003)</td>
<td>14.3</td>
<td>18.1</td>
</tr>
<tr>
<td>Russia (2003)</td>
<td>9.1</td>
<td>15.6</td>
</tr>
<tr>
<td>Brazil (2004)</td>
<td>6.3</td>
<td>–</td>
</tr>
<tr>
<td>Finland (2007)</td>
<td>33.8</td>
<td>24.8</td>
</tr>
<tr>
<td><strong>India (2008)</strong></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>South Africa (2008)</td>
<td>16.2</td>
<td>16.2</td>
</tr>
<tr>
<td>Malaysia (2009)</td>
<td>20.7</td>
<td>17.4</td>
</tr>
<tr>
<td>Philippines (2009)</td>
<td>47.1</td>
<td>50.0</td>
</tr>
</tbody>
</table>


Note: The year that a country adopted a Bayh–Dole like university technology policy is shown in parentheses. India is listed in italics because legislation was proposed in 2008 that would affect university-based technology transfer, but it was tabled in 2014.

There is, of course, a market for licensable or patentable technology from a university.\(^{14}\) Table 1.2 describes participation in this market from the perspective of the university. Table 1.3 presents, to the best of our knowledge, a complete list of countries that have adopted Bayh–Dole like university technology transfer legislation. The data in the table approximate, or so we contend, participation in this market from the perspective of the firm. In the table are the percentage of firms that cooperate in innovation (a concept that UNESCO, 2015 did not clearly

\(^{14}\)See Bradley et al. (2013) for a discussion of technology transfer at universities.
1.2. A Public Sector Entrepreneurship Lens

define) with universities and HEI as well as with government or public research institutes. Across the countries listed, the mean percentage of firms that cooperate with universities and HEIs is 15.3, the mean percentage of firms that cooperate with government or public research institutes is 13.9.

As a final across-country example of the “uncertainty” (a public sector entrepreneurship characteristic; see Table 1.1) about the effectiveness of Bayh–Dole like legislation, consider the data in Table 1.4. Across countries, universities, HEIs, or government or public research

Table 1.4: Percentage of firms reporting an information source as being “highly important,” 2014 (selected countries)

<table>
<thead>
<tr>
<th>Country</th>
<th>Universities or Other Higher Education Institutions</th>
<th>Government or Public Research Institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain (1983)</td>
<td>5.0</td>
<td>7.7</td>
</tr>
<tr>
<td>United Kingdom (1985)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>China (1994)</td>
<td>8.9</td>
<td>24.7</td>
</tr>
<tr>
<td>Denmark (1999)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>France (1999)</td>
<td>3.4</td>
<td>3.1</td>
</tr>
<tr>
<td>Japan (1999)</td>
<td>5.1</td>
<td>4.8</td>
</tr>
<tr>
<td>South Korea (2000)</td>
<td>3.9</td>
<td>6.1</td>
</tr>
<tr>
<td>Italy (2001)</td>
<td>3.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Austria (2002)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Germany (2002)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Indonesia (2002)</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Mexico (2002)</td>
<td>26.4</td>
<td>23.6</td>
</tr>
<tr>
<td>Norway (2003)</td>
<td>7.2</td>
<td>10.5</td>
</tr>
<tr>
<td>Russia (2003)</td>
<td>1.9</td>
<td>–</td>
</tr>
<tr>
<td>Brazil (2004)</td>
<td>7.0</td>
<td>–</td>
</tr>
<tr>
<td>Finland (2007)</td>
<td>4.5</td>
<td>2.8</td>
</tr>
<tr>
<td>India (2008)</td>
<td>7.9</td>
<td>11.0</td>
</tr>
<tr>
<td>South Africa (2008)</td>
<td>3.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Malaysia (2009)</td>
<td>9.5</td>
<td>16.7</td>
</tr>
<tr>
<td>Philippines (2009)</td>
<td>10.1</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Note: The year that a country adopted a Bayh–Dole like university technology policy is shown in parentheses. India is listed in italics because legislation was proposed in 2008 that would affect university-based technology transfer, but it was tabled in 2014.
Introduction

Institutes are not noted to be “highly important” sources of information for firms.

The legislators in the countries listed in Tables 1.3 and 1.4 must have perceived or recognized an opportunity for “transforming a status quo economic environment” (see Table 1.1) as evidenced by the passage of Bayh–Dole like legislation in the face of uncertainty.

1.2.1 Research Related to the Bayh–Dole Act

Perhaps the most frequently asked question about the Bayh–Dole Act has been: How did the Bayh–Dole Act affect university patenting? Many scholars have carefully investigated this question—and it is indeed an important question in the relevant academic research literature from a policy evaluation perspective—as evidenced through the application of various econometric models by various researchers from different disciplines. Specifically, scholars have estimated time series of patent application data either at a specific university, or among selected universities, or in the aggregate using a dichotomous variable to define the year when the Bayh–Dole Act became active (either in 1980 or in 1981 to account for a lag). Drawing on individual publications as well as on the excellent syntheses of this literature by, among others, Berman (2008, 2012) and Grimaldi et al. (2011), the empirical evidence about the patenting effect of the Bayh–Dole Act remains mixed.

Few scholars doubt that after the passage of the Bayh–Dole Act, university patenting increased, and it increased substantially at some universities, but many scholars also note that there were other events occurring just before and just after the passage of the Act that are also covariates with an increase in university patenting. We have summarized a portion of this important body of literature in Appendix A to provide background context for the remaining sections in this monograph.\(^{15}\)

The most recent, and perhaps a more salient, argument about the economic impact of the Bayh–Dole Act has been offered by Link and van

\(^{15}\)The literature review is based on the excellent graduate research assistance of Kelsi Hobbs. Our omission of scholarly work from Appendix A is unintentional.
Hasselt (2019). They argue, and they show empirically, that the Bayh-Dole Act had a measurable impact on universities forming and opening technology transfer offices (TTOs), which are a prerequisite infrastructure for university in-house patent applications. More specifically, Link and van Hasselt (2019, p. 478) conclude:

Whereas the literature has focused on university patenting activity as the relevant metric for assessing the technology impact of the Act, we suggest that the establishment date of TTOs relative to the passage of the Act is also an appropriate metric, and in fact it might be a more appropriate one. Our argument is that formal university patenting generally begins after the establishment of a TTO. . . . [Our empirical findings give] support for the argument that the Act provided an incentive for universities to establish a TTO and thus to position themselves for formally transferring faculty inventions through patent licensing.

Perhaps the effect of the Bayh-Dole Act on the institutionalization of university research is what was meant in The Economist article by the statement: “More than anything, this single policy measure [known as the Bayh-Dole Act] helped to reverse American’s precipitous slide into industrial irrelevance.”

We suggest that one would be hard pressed to argue against the point of view that the establishment of TTO infrastructure at U.S. universities did transform a status quo academic as well as economic environment into one that is more conducive for dealing with the uncertainty of research and that transformation can eventually lead to economic growth and social wellbeing.

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16See also Coupé (2003).
17Bozeman and Link (2015) argue that it is difficult, if not impossible, to disentangle one post-productivity slowdown policy for another when explaining the subsequent increase in industrial R&D investments.
1.3 Overview of the Monograph

Our thesis in this monograph is that, in addition to the formation of university technology transfer offices and the university patent applications that followed, an overlooked metric associated with the Bayh–Dole Act is its effect on influencing university-based technology transfer policies in other countries; we refer to this phenomenon by the phrase *The Globalization of the Bayh–Dole Act* (which is also the title of this monograph).\textsuperscript{18}

To substantiate this thesis, we review related university technology transfer policies in 20 other countries in Section 2 of this monograph. Of course, the scope of these related policies varies from country to country, but one cannot help but notice that there are seeds from the Bayh–Dole Act present in all of them. We discuss these country policies below in chronological order based on the year of the initiating legislation.

We conclude this monograph in Section 3 with summary remarks and suggestions for future policy related research. Our attempted tone throughout this monograph is descriptive, that is we have attempted to report in a non-assessing or non-evaluative manner the pattern of globalization of the Bayh–Dole Act.\textsuperscript{19} However, we do note in Section 3 some correlative patterns. We do so to help to motivate our proffered research agenda.

\textsuperscript{18}Graff (2007) uses the phrase *Echoes of Bayh–Dole*. See also, Hemel and Ouellette (2017).

\textsuperscript{19}As Link and Scott (2011) have written, many use the terms *assessment* and *evaluation* interchangeably, especially with reference to public sector activities. Program or legislation assessment is based primarily on the criterion of effectiveness: Has the program or legislation met its stated goals and objectives; have its designated outputs been achieved? Program or legislation evaluation is based on the criterion of efficiency: How do the social benefits or outcomes associated with the program or legislation compare to the social costs?
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