What is the Total Economic Impact
of
Academic Technology Transfer?

by

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AUTM will shortly be publishing the results of its 1992 royalty survey. While the results will undoubtedly make our collective hearts swell with pride, because, as I'll show below, the total will most likely exceed $200 million, I also believe there is a strong possibility that this figure could make us victims of our own success and cause us grief in Washington. "$200 million in proceeds from research that the Government paid for?" some congressional staffer will say, "The Government should get some of that back." In fact it's already started; one of the aspects of the Wyden Bill that many find unfortunate is a requirement to share royalties with the Government?

One way to handle this problem is to divert the debate from what <u>Universities</u> are getting as a result of their technology transfer activities to the benefits to <u>society as a whole</u>. To come up with an accurate assessment of the total economic impact resulting from our collective efforts is undoubtedly a major task that will require a lot of study; however I believe it is critical that we not be embarrassed to put a defensible figure in the public debate right now. I submit that a reasonable estimate is that academic technology transfer contributed sales of $7.4 billion and 43,800 jobs to the US economy in 1992; that this contribution is growing at some 25-30% a year; and that the governments at all levels are already benefiting by around $1.5 billion in taxes <u>annually</u> from this economic activity.

In the rest of this article, I'll lay out the bases for these estimates. As you'll see, my methodology is crude and I know the answers are off by at least 50%. Unfortunately, I don't know if they're high or low!

<u>Total Royalty Income</u>

First, how do I come up with the estimate of $200 million for 1992? I did it by a meta analysis of past royalty surveys. Being a pat-rack for data, I've accumulated as many royalty studies as I could find over the years. There were a slew of reasonably detailed studies in the 1988-91 time period; there are relatively few prior to then. The ones I included in the analysis are:.

NSB	1980	Selected Studies in University-Industry Research Relationships

An excellent review of all aspects of University-Industry relationships. Contains a royalty survey for 1980 and 1981 based on responses from 25 Universities. Reported $7.3 million for 1980 and $9.2 million for 1981.

U. of CO   1986   Presentation to AUTM

This survey was of the Big 8 and 7 other major Universities for 1986 and gave a total of $15.3 mm. Was presented to the 1987 AUTM annual meeting.

GAO   1986   Foreign Sponsorship of US University Research

Buried in the methodology summary at the back, it reports royalty income of $30.3 mm for 112 Universities

AUTM 1988   Survey

This survey reported $60.28 mm for 71 Universities, and gave individual figures for about half. I believe Terri Wiley's 1989 study drew on this data.

John Preston   1988   Talk

John included royalty of 7 universities in his standard talk, primarily those with large royalty incomes -- $38.3 mm for these 7.

AUTM 1989, 90 and 91   Survey reported at San Francisco Annual Meeting

This was a very important study because it gave a self consistent set of responses for 25 universities and 3 hospitals for all three years, plus 10 others for 1990. It reported $43.7 mm for 1989, $120.2 mm (including the Memorial Sloan Kettering G-CSF lump sum payment) for 1990 and $72.3mm for 1991.

GAO   1989+1990   Controlling Inappropriate Access to University Research

This study reported total royalty income for 35 Universities of $113 mm for the two fiscal years in question <u>combined</u>, of which $81.8 mm came from research solely funded by NIH/NSF. It included several universities with substantial royalty income such as WARF and MSU who had not previously reported to AUTM. For this analysis, I apportioned the reported royalties 45% to 1989 and 55% to 1990.

This collection of studies gives us single, good figures for the years 1980, 81, 86 and 88, while there appears to be a redundancy of studies for the 1989-91 period indicating totals ranging from $40-60 million for 1990 (the figure that Bernadine Healy used in her recent congressional testimony.) However if you examine the details of which institutions were represented in which of the 1989-91 surveys, it's clear that the different studies included completely different sets of Institutions. If you construct a consensus of the 1990 data,

including figures for every Institution that reported to at least one of these surveys, you obtain data for 64 institutions with total royalty income of $103 mm.

I therefore submit the following as the best time series we can come up with:

Year	Royalty Income	Number of Institutions
1980	7.3	25
1981	9.2	25
1986	30.3	112
1988	60.4	71
1990	102.7	64

This shows a compound annual growth rate of between 25% (1980-81) and 35% (1986-90) per year. These extraordinary growth rates are corroborated by other self consistent data sets that are available, such as:

the three year (1989-1991) AUTM survey   -- 26.7%; 37.5%

the ten year combined Federal Lab income   -- 15%-29%

the five year RCT gross Income (1987-1991) -- upto 25%

Adjustments

However, impressive as this figure for 1990 is, a number of adjustments are needed.

    a.   Cohen-Boyer.

Licensees pay the royalties due to Stanford who report it as income and promptly forward 42.5% to UCSF, who also report it as income, thereby resulting in a double counting. 1990 Cohen-Boyer income was $16.9 mm, so $7.2 mm should be deducted from the total.

    b.   Research Corporation Technologies

Research Corp. distributes about 60% of its total income to the universities where the technology originated. This distribution will show up in the universities' reported royalty income. However, the portion that RCT retains should also be added into the total, since it reflects the results of academic research. This adjustment was $10.3 mm in 1990

    c.   City of Hope

City of Hope worked closely with Genentech in their early days and did much of the genetic engineering of insulin, etc. Their royalty income is one of the largest

around but has not been included in any of the previous surveys. Their income was $15.1 mm in 1990 and this has been added.

      d.   Federal Labs

Federal Lab Royalty Income was $9.4 mm in 1990 and should be reflected in the total.

With these adjustments (plus Dana-Farber's income of $1.5 mm, which has not been previously reported) total royalty income for 1990 becomes $132 mm, double that reported in any of the individual surveys for the year.

At the compound growth rate of 25% that this study shows to be the case, 1992 royalty income is expected to be at least $205.8 mm, including Federal Labs. AUTM will probably report a higher total because this figure is based on only 66 institutions plus the Federal Labs.

Conversion to Macroeconomic Data

a.   Product Sales

To work back from royalties to product sales requires estimating the royalty rate paid, and there is very little data on this. I've assumed an average royalty rate of 3%. I chose this number as a composite of the 4-8% rate typical for an exclusive license royalty rate for a product and the 1-2% rate typical for a non-exclusive license to enabling technologies such as Cohen-Boyer, Columbia's cotransformation patent and the Iowa State Group 3 fax algorithm.

The assumption of an average royalty rate is the one of several weak points in this analysis. However, with this estimated royalty rate, product sales of $6.9 billion can be estimated.

One further adjustment should be made. As noted above, Sloan-Kettering allowed Amgen to buy back the bulk of their royalty obligations for G-CSF for a lump sum payment of $50 mm in 1990. Therefore, G-CSF royalties will not show up in annual reports. Sales of G-CSF should therefore be added to total product sales back calculated from royalties. 1992 G-CSF sales were around $540 mm, so total product sales directly attributable to academic technology total $7.4 billion.

Another weak point is that we have no way of knowing what products are subject to multiple licenses and hence are double counted by this method. For example, Amgen owed royalties for G-CSF to Sloan-Kettering, where it was cloned, but also to Stanford for Cohen-Boyer, used in the production process, and to Nycomed for another production patent. On EPO, cloned internally and hence not subject to royalties to an academic institution for the composition of matter, Amgen uses the Columbia cotransformation patent in the production process.

Finally, not all reported royalty income is earned income on sales -- some upfront fees are included.

Jobs Resulting from Academic Technology

A recent issue of Business Week calculated that in 1992, S&P 500 companies had sales of $169,000 per employee. Using this figure, we can calculate that 43,800 jobs were directly attributable to academic technology in 1992. As noted above, this figure is growing by at least 25% a year.

Benefit to the Government from this Economic Activity

The drafters of Bayh-Dole explicitly intended the Government to obtain its economic return from its largesse in allowing Institutions to elect title to inventions made with Government funding by the taxes that would result from the increased economic activity, not from a share in the royalties. So, lets examine how the Government's doing.

As a very simplistic model, let's assume that each worker whose job results from products derived from academic technology earns $50,000, on which (s)he'll pay 21% in taxes after $10,000 of deductions. Let's assume (s)he owns a house that is worth 2.5 times his/her salary and let's assume that (s)he lives in a state with a 5% state income tax, no local income taxes but property taxes that average 2% of the market value of the house. Let's further assume that the company earns a 25% pre-tax profit on the products sold and pays taxes at a 34% Federal and 5% state corporate tax rate.

On these bases, tax flows to the Federal, state and local governments would be as follows :

		($ million)
Federal Government	Personal Income Tax	$368
	Social Security Tax	$268
	Corporate Income Tax	$629
State	Personal Income Tax	$88
	Corporate Income Tax	$93
Local	Personal Property Tax	$88
Total		$1,533

You can argue with any of my many individual assumptions, but the bottom line conclusion is inescapable -- the Bayh-Dole Act is working exactly as intended and government at all levels is reaping a handsome return from the results of academic technology.

Stand proud!