Chapter 12

Financing and Tax Incentives for Firms

Contents

Page

Introduction. 269
Financing in Firms Commercializing Biotechnology 269
  Financial Needs of Firms Commercializing Biotechnology 269
  Sources and Availability of Financing for U.S. Firms 273
  Sources and Availability of Financing for Firms in Other Countries 284
Tax Incentives Relevant to Firms Commercializing Biotechnology 288
  Tax Incentives Relevant to New Biotechnology Firms in the
    United States and Other Countries 291
  Tax Incentives Relevant to Established Companies in the
    United States and Other Countries 295
Findings 297
Issues and Policy Options 300
Chapter 12 References. 302

Tables

Table No. *Page*

41. Breakdown of Revenues and Net Income/Losses for
    18 New Biotechnology Firms in the United States, Fiscal Year 1982 270
42. Capital Expenditures, R&D Budgets, and Operating Revenues of
    Nine New Biotechnology Firms in the United States, Fiscal Year 1982 271
43.Cash Drain Relative to Equity for Six New Biotechnology Firms
    in the United States, Fiscal Year 1982 271
44. Distribution of Venture Capital Disbursements in the
    United States by Industry, 1980 and 1981 275
45. Distribution of Venture Capital Disbursements in the United States
    by Stage of Investment, 1981 275
46.Cost of Venture Capital for Selected New Biotechnology Firms in the United States 276
47. Comparison of Private and Public (Market) Valuations of Eight New
    Biotechnology Firms With Initial Public Offering in 1983 277
48.U.S, Venture Capital Pool, 1977 and 1982 278
49.R&D Limited Partnerships Used by 12 New Biotechnology Firms
    in the United States 278
50. Initial Public Offering History and Market Valuations as of
    July 1983 for 19 New Biotechnology Firms in the United States 282
51. Number of Initial Public Coffering sand Amount Raised in All Industrial
    Sectors in the United States, 1972-83 282
52. Amounts Raised in Recent Initial Public Offerings by Six New Biotechnology Firms 283
53.Tax Treatment of Innovation Activities in the United States and Other Countries 289
54. Estimated Relationship Between Tax Credit Earned and U.S. Firm Size 296

Figure

Figure No. *Page*

30. Comparative Market Performance: Companies Using Biotechnology vs.
    Standard and Poor's 500 Companies, April 1982 through April 1983 281

Chapter 12

Financing and Tax Incentives for Firms

Introduction

Two of the most important factors in the development of biotechnology in the United States have been the supply of venture capital to finance the startup and growth of new biotechnology firms (NBFs)* and the tax incentives provided by the U.S. Government to encourage capital formation and stimulate research and development (R&D) in the private sector. As noted in ***Chapter 4: Firms Commercializing Biotechnology,*** the types of companies commercializing biotechnology in the United States include a large number of NBFs and a smaller yet growing number of established companies from a variety of industrial sectors. In Japan and the European countries, by contrast, it is predominantly established companies that are commercializing biotechnology. A variety of reasons might explain the different nature of foreign commercialization efforts, but certainly of major importance is the fact that venture capital to fund the startup of new companies is not generally available outside the United States.

● NBFs, as defined in *Chapter 4: Firms Commercializing Biotechnology*, are firms established around 1976 or later specifically to pursue applications of biotechnology

The first section of this chapter examines financial needs of firms commercializing biotechnology, emphasizing the needs of NBFs in the United States. It also evaluates the sources and availability of capital for firms in the United States and other countries. The second section examines tax incentives for firms. Tax incentives are an indirect source of government funding.** Such incentives can expand or contract the supply of funds available to companies engaged in biotechnology and can thereby affect the overall rate at which biotechnology develops. They also can affect the financial decisionmaking and thus the methods of financing used by companies applying biotechnology.

**Direct government funding of basic and applied research is treated in *Chapter 13: Government Funding of Basic and Applied Research*. Direct government funding in the United States is provided exclusively for research. In some countries, notably Japan, the Government provides direct funding to industry. Such funding is discussed in this chapter.

Financing in firms commercializing biotechnology

Starting a new company, expanding the product line of an existing company, and manufacturing an existing product in a new way all require some form of financing. The discussion below outlines the financial needs of US. companies applying biotechnology. It also examines the sources and availability of private sector funds to meet these needs. Brief comparisons are made with the five countries likely to be the major competitors of the United States in the commercialization of biotechnology—Japan, the Federal Republic of Germany, the United Kingdom, Switzerland, and France.

Financial needs of firms commercializing biotechnology

As discussed in chapter 4, a distinction can be made in the United States between two types of firms that are active in the commercialization of biotechnology: NBFs and established companies. NBFs, as defined in this report, are firms established around 1976 or later specifically to pursue applications of biotechnology. * Established

*Cetus (U.S.) and Agrigenetics (U.S.), though established before 1976, are included in the NBF category. Cetus was founded to capitalize on classical genetic techniques for product development.

(footnote continued on next page)

companies have considerably longer corporate histories than NBFs and are generally much larger. In Japan, the Federal Republic of Germany, the United Kingdom, Switzerland, and France, efforts to commercialize biotechnology are led by established companies, although the United Kingdom and France do have a few NBFs. Because of their large financial assets, established companies generally do not need external sources of funds for R&D in new areas such as biotechnology. Furthermore, if they do need such funds, established companies are generally able to obtain debt financing. Debt financing, a traditional means to fund corporate growth, is not available to NBFs, because they lack both collateral to secure a loan and sufficient means to repay the lender (27). The discussion in this section, therefore, focuses on the financial needs of NBFs.

(continued)
It showed early interest in biotechnology and began aggressively pursuing product development with the new techniques. Agrigenetics was formed in 1975 to link new genetic research with the seed business. Thus, the behavior and research focus of both Cetus and Agrigenetics places them in the new firm category despite their early founding dates.

Even the most mature NBFs at present have only a few products to generate revenues that can be used to cover operating expenses and provide capital for future growth. In order to generate revenue, as described in chapter 4, NBFs in the United States are currently relying heavily on research contracts. The reliance of entrepreneurial firms on research contracts to generate revenue is almost without parallel, except perhaps for the small firms that do defense contracts.

Table 41 shows profitfloss figures for 18 NBFs in the United States, all of which are publicly held. Of these firms, only three, Cetus, Genentech, and International Genetic Engineering (INGENE), have shown earnings in the most recent fiscal year for which data are available. The favorable financial position of Cetus and Genentech is mostly due to earned interest income from funds obtained in public offerings. However, revenues from sales (including contract research) fall far short of expenses for all three of these companies, and all three are losing money on an operating basis.

As shown in table 42, NBFs' investment in R&D is currently very large in comparison to their op -

Table 41.—Breakdown of Revenues and Net Income/Losses for 18 New Biotechnology Firms in the United States, Fiscal Year 1982 (millions of dollars)

	Operating revenues						
New biotechnology firm	Revenues from research	Contract revenue as a percent of total revenues	Revenues from product sales or royalties	Total	Interest income	Total revenues	Net income/loss[a]
Amgen[b]	$ 0.13	9.4 %		~ OTIS	$1.35	$ 1.5	($/u)
Biogen	12.1	58,8		12.1	8.5	*20.6*	(3.9)
Biotechnica International	0.031	34		0.031	0.059	0.09	(1.6)
Bio-Technology General	0.15	93		0.15	0.16	0.011	(2.3)
Centocor	2.4	84.2		2.4	0.45	2.85	(2.76)
Cetus	15.2	46.5	$0.79	15.99	16.7	32.7	
Chiron[b]	1.58	92		1.58	0.14	1.72	(;:2)
Damon Biotech	0.81	48		0.81		1.7	(1 .38)
Enzo Biochem[c]	0.10	11.2	0.17	0.27	*0.62*	0.89	(1.25)
Genentech[c]	28.8	88.3		28.8	*3.76*	32.6	0.625
Genetic Systems	2.2	71.66		2.2	*0.87*	3.70	(1.0)
Genex	5.2	85.3		5.2	*0.67*	6.1	(5.6)
Hybridoma Sciences[d]	0.07	73		0.07	*0.024*	0.095	(0.186)
Hybritech	1.3	27.4	1.8	3.1	*1.6*	4.75	(7.26)
Integrated Genetics	0.6	60		0.6	*0.46*	1.0	(1.76)
International Genetic Engineering (Ingene)	1.78	90		1.78	0.211	*1.98*	0.13
Molecular Genetics	0.66	61		0.66	0.42	1.08	(3.75)
Monoclinal Antibodies[b]	0.10	1.5	0.16	0.26	0.39	*6.5*	(2.7¦

[a] Losses are shown in parentheses.
[b] Fiscal year 1983.
[c] Stock split
[d] Units offered (one unit= three shares of common stock and three Class A Warrants).

SOURCE Office of Technology Assessment, based on information from E F. Hutton & Co, comPany annual reports, and company prospectuses

Table 42.—Capital Expenditures, R&D Budgets, and Operating Revenues of Nine New Biotechnology Firms in the United States, Fiscal Year 1982 (miiiions of doiiars)

New biotechnology firm	Capital expenditures	R&D budget	Operating revenues	R&D as a percent of operating revenues
Biogen	$8.7	$8,7	$12.1	720/o
Cetus	22.9	25.9	16.0	143
Enzo Biochem	0.09	1,2	0.3	400
Genentech	31.8	31.9	28.8	111
Genetic Systems	0.46	3.9	2.2	177
Genex	1.8	8.3	5.2	160
Hybritech	1.44	5.0	3.1	161
Molecular Genetics	1.4	2.8	0.66	424
Monoclinal Antibodies	0.57	1.1	0.26	423

SOURCE: Office of Technology Assessment based on information from company annual reports.

crating revenues. Furthermore, NBFs that are incurring large R&D costs to develop products are sustaining large losses relative to their earnings (see table 41). * These losses, which will likely continue for several years, are eroding the capital bases of many NBFs and increasing their need for additional sources of funds. NBFs such as Biogen N. V.* * do not expect operating revenues to meet R&D expenses, and consequently do not expect to operate at a profit for at least several years (2). For the next several years, expenditures by NBFs for R&D will probably equal 20 percent or more of sales (27).

● The cumulative losses shown in table 41 understate the level of funding required to sustain these companies because they do not fully reflect capital outlays. Only the depreciated portion of capital outlays shows up in a profit and loss statement and, hence, in cumulative loss (27).

•*Biogen N.V., the parent company of the Biogen group, is registered in the Netherlands Antilles but is about 80-percent U.S. owned. Biogen's principal executive offices are located in Switzerland. Biogen N V. has four principal operating subsidiaries. Biogen Research Corp. (a Massachusetts corporation) and Biogen S.A. (a Swiss corporation) conduct research and development under contract with Biogen N.\'. Biogen B.V. (a Dutch corporation) and Biogen Inc. (a Delaware corporation) conduct marketing and licensing operations, Available figures pertaining to Biogen refer to Biogen N.V. and its subsidiaries.

Because of the emphasis on R&D in biotechnology, skilled labor for firms applying biotechnology is relatively more important than labor for firms in other areas, Such labor is also quite expensive. The average Ph. D., supported by two technicians, costs on the order of $150,000 to $175,000 per year with overhead (27). As a result, labor may initially constitute a large percentage of a new firm's operating expenses.

The most revealing indicator of the NBFs' potential need for cash is the ***rate*** at which such firms are consuming funds. Table 43 shows decreases in working capital for six NBFs. Except for Cetus, which raised an exceptional amount of money in its initial public offering, the drop in working capital for these firms is large compared to their equity capital. In 1981, Genentech used up 21 percent of its ending equity capital, while Molecular Genetics used up 10 percent, and Cetus 12 percent (27). Hybritech increased its working capital by 72 percent of beginning equity in 1981 by means of a public stock offering; by October 1982, however, Hybritech had returned to the public markets to raise additional equity because its

Table 43.—Cash Drain Relative to Equity for Six New Biotechnology Firms in the United States, Fiscal Year 1982 (miiiions of doiiars)

New biotechnology firm	Equity capital	Cash flow[a]	Yearly change in working capital	Cumulative deficit
Biogen	$61.9	($3.0)	($12.1)	$10.0
Cetus	128.3	5.7	(15.7)	(0.3)
Genex	13.3	0.6	(9.4)	(2.3)
Genentech	53.1		(1 1.4)	(0.03)
Hybritech	17.6	(i::)		(12.8)
Molecular Genetics	1.5	(3.6)	(%	(4.0)

a cash flow is sum of net income or ıoss pıus noncash expenses such as depreciation.

SOURCE' Office of Technology Assessment, based on information from company annual reports

working capital had dropped to 43 percent of stockholder's equity by the end of 1981 (27). Other NBFs, including Monoclinal Antibodies, Genex, and Molecular Genetics, have also had to return to the public market not long after their initial or second public offerings.

The financial needs of NBFs are largely dependent on which market they are trying to enter. To enter each of the markets described below, increasing amounts of funds are necessary.

Contract Research and Development Market. The funding needed to support entry into the contract R&D market is generally less than that required for entering product markets, because research that a firm does for another company, university, or government agency is funded by that organization, often through progress * or advance payments. Most NBFs perform contract R&D to generate revenues to fund their own proprietary research, although the costs of proprietary research generally exceeds their contract research fees (27).

***In Vitro Monoclinal Antibody Diagnostic Products Market. * *** The funding needed to support entry into the market for in vitro (used outside the body) monoclinal antibody (MAb) products is more than funding needed to support entry into the contract research market. Because of the small amount of plant and equipment required to develop such products and because of the comparatively low cost of complying with the Food and Drug Administration's (FDA's) testing requirements for in vitro diagnostic products for humans, the financial requirements are relatively low. * * * A number of NBFs, including Hybritech, Monoclinal Antibodies, Molecular Genetics, Cen - tocor, and Genetic Systems, have developed in vitro MAb diagnostic products for humans that are "substantially equivalent" to products that FDA has already approved and thus do not require rigorous testing. Other MAb products being developed by these firms are intended for research or production (e.g., separation and purification) purposes and thus do not require FDA approval. Several of these NBFs are within a few quarters of achieving operational profitability for these product lines (27).

***Specialty Chemicals Market. ** *** Specialty chemicals are defined in this report as chemicals whose price exceeds $1 per pound (50¢ per kilogram). These include substances such as enzymes, amino acids, vitamins, fatty acids, and steroids. Most specialty chemicals do not need regulatory approval. For specialty chemicals considered foods or food additives, however, FDA approval is required, and significant funds may be expended to meet FDA requirements. Thus, the amount needed to enter the specialty chemicals market varies depending on the product. In general, though, the amount of funds needed to enter the specialty chemicals market is more than the amount required to enter the contract research market but less than that needed to enter the commodity chemicals market.

***Agricultural Products Market. * *** For the animal agricultural market, the R&D cost are very similar to those for pharmaceuticals (in vitro and in vivo products), because many of the products, such as diagnostics, vaccines, and hormones, are essentially the same. However, the regulatory requirements promulgated by the U.S. Department of Agriculture (USDA) and FDA for animal health products are much less stingent than the requirements for pharmaceuticals. Some animal agriculture products (e.g., vaccine for colibacillosis) have received approval and are already reaching the market.

The R&D costs for applications of biotechnology to plant agriculture vary over a broad range. The genetic manipulation of microorganisms important to plant agriculture, for the most part, is less costly than the genetic manipulation of the plants themselves. Furthermore, the various traits being investigated are at different stages of research. For instance, plants with traits conferring resist - ance to drought or saline stress are more near term than those with improved photosynthesis or nitrogen fixation. The financial requirements for developing the latter plants are much greater

" Progress payments are received when the contracting company reaches certain milestones in the research project.

• • In vitro MAb products are d iscussed i n *Chapter 5. Pharmaceuticals.*

•* ● 1;0f a discussion of FDA 's regulatory processes, see *Chapter 15: Health, Safety, and Environ nental Regulation.*

" Applications 01 biotechnology to specialty chemicals are discussed in *Chapter 7: Specialty Chemicals and Food Additives.*

* • Applications of biotechnology to animal and plant agriculture are discussed in *Chapter 6: Agriculture*

than those for developing simpler genetic applications. Firms doing research in the more complex agricultural applications of rDNA technology are unlikely to have commercial products available until the late 1980's or 1990's. Some companies, such as Plant Genetics (U.S.), hope to finance themselves through the research period by developing commercial products using conventional plant genetics (27).

*In Vivo Diagnostic and Therapeutic Products Market.** The financial requirements for entering the market for in vivo (inside the body) diagnostic and therapeutic products for human use are very large, in part because such products require extensive clinical testing to meet FDA regulatory requirements. Taking a pharmaceutical product from research to market in the United States generally requires 7 to 10 years and costs $70 million or more (14). To date, no NBFs attempting to enter this field are operationally profitable, nor are they likely to be in the near future (27). Hybritech, for example, does not anticipate profitability for its therapeutic line until about 1988 (26).

*Commodity Chemicals Market.*** For several reasons, the financial requirements for entering the commodity chemicals market are the largest. Currently, practically all commodity chemicals, defined in this report as chemicals that sell for less than $1 per pound, are made from petroleum feedstocks. Although it is theoretically possible to produce essentially all commodity chemicals from biomass feedstocks such as starch or cellulose, and most commodity chemicals can be synthesized biologically, most commodity chemicals derived from biomass cannot yet compete economically with chemicals made from petroleum in the highly integrated production infrastructure that now exists. Furthermore, profitability in commodity chemicals requires the achievement of economies of scale in production plants costing hundreds of millions of dollars (27).

With the exception of firms developing in vitro MAb assays and diagnostic products, it will be some time before NBFs, most of which are U.S. companies, can be self-financing; some estimate that NBFs cannot be self-financing before the late 1980's ***(27).*** The new firms must finance not only losses due to operating expenses but also expenditures needed for capital assets. For some NBFs, meeting FDA regulatory requirements will also require substantial funds. Because, as noted earlier, debt financing may not be available to many NBFs, the financial needs of these firms must for the most part be met by additions to equity capital (27). Thus, in many cases, the receptivity of the public market to NBF stock issues and the use of R&D limited partnerships is a matter of" great importance.

Sources and availability of financing for U.S. firms

The sources and availability of financing for the two types of firms that are important to the development of biotechnology in the United States—i.e., NBFs and established companies—are quite different. The discussion below, therefore, treats each type of firm separately.

NEW BIOTECHNOLOGY FIRMS

The main sources of financing for NBFs, the small, new firms specializing in biotechnology, are the following:

- revenues from contract research and interest on cash previously obtained from public or private offerings;
- various sources of venture capital; and
- public stock offerings.

Revenues From Contract Research, Product Sales or Royalties, and Interest.— Research and product development agreements between NBFs and established companies are generally cost reimbursement contracts with additional fees and incentives for reaching agreed on milestones. The NBF generally retains the patent rights to any technology involved and grants the contracting company an exclusive license to that

* Applications of biotechnology to in vivo diagnostic and therapeutic products intended for human use are discussed in ***Chapter s: Pharmaceuticals.***

** "Applications of biotechnology to commodity chemical production are discussed in ***Chapter 9: Commodity Chemicals and Energy Production.***

technology. Thus, such agreements usually provide for royalty payments to the NBF by the established company on the future sales of the product that results from the R&D work; these royalties may range from 2 to 10 percent of total sales, depending on the size of the product market.

Table 41 breaks down total fiscal year 1982 revenues for 18 NBFs into operating revenues received from contract research or product sales or royalties and interest income. In most NBFs, no income or very limited income was obtained from the sale or licensing of products. Most revenue, even for the larger NBFs such as Genentech, Cetus, and Biogen, was contract revenue and interest on cash raised through public offerings and private investment. Genentech reports, for example, that 88 percent of its total $32.6 miilion revenue in 1982 was derived from contracts and the balance derived from interest income. Cetus reports that, in fiscal year 1982 (which ended in June 1982), income from contracts accounted for almost 47 percent of its total revenues and interest income for most of the remainder. Similarly, Biogen reports that 59 percent of its revenue comes from contract sales with the balance being interest income.

Biogen and Genentech are concentrating on product development using rDNA technology. Some NBFs, including Genetic Systems, Monoclinal Antibodies, Centocor, and Hybritech, are developing MAbs for in vitro assays, diagnostics, and research products. These firms will probably achieve an income stream from product sales more quickly. In fiscal year 1982, however, these firms also show primarily interest income. Currently, Hybritech has the greatest percentage of total revenue coming from product sales, 38 percent. In the near future, product sales should contribute more substantially to revenues for Hybritech as well as other diagnostic product companies.

Venture Capital.—In the United States, there are several sources of venture capital. These are:

- corporate venture capital,
- R&.D limited partnerships,
- venture capital funds, and
- Small Business Investment Corporations (SBICS).

Each of these is discussed further below.

From 1969 to 1977, the total venture capital pool in the United States remained relatively unchanged, at the level of about $2.5 billion to $3 billion each year (27). Since then, however, the venture capital pool has increased sharply, reaching between $3.5 billion and $4 billion in 1979 (45), $5.8 billion in 1981 (46), and an estimated $7.5 billion as of the end of 1982 (48).

Variability in the amount of venture capital in the United States is influenced by many factors. These include general macroeconomic variables (e.g., interest rates and inflation), changes in capital gains tax laws, and changes in pension fund investment rules. In 1969, the U.S. capital gains tax was increased from 29 to 49 percent. In addition, the U.S. inflation rate increased sharply in 1972, causing investors to seek a much higher rate of return on their investments, In 1973-74, the price index of the National Association of Security Dealers Quotation of over-the-counter securities, which represents smaller companies, declined more than did the Dow-Jones industrial price index, which represents larger companies (27), indicating a decline in investor interest in newer, smaller firms relative to larger, more established companies.

Recent changes in U.S. laws and regulations affecting the formation of venture capital have led to a resurgence in the supply of venture capital in this country. In 1979, Employee Retirement Income Security Act pension fund regulations were interpreted to allow some pension fund money to flow into venture capital investments. Around the same time, the Securities and Exchange Commission adopted Rule 144 allowing founders of companies to liquidate their “restricted” stock holdings sooner than previously allowed. The opportunity to liquidate sooner provides investors with a stronger incentive to invest. Especially important to the supply of venture capital in the United States have been decreases in the rate at which long-term capital gains are taxed. The current long-term capital gains tax rate for individuals, established under the Economic Recovery Act of 1981, is 20 percent (28 percent for corporations), making venture investments even more attractive than they were under the pre-1969 rate of 29 percent.

Table 44 shows the distribution of venture capital disbursements in the United States by industry for 1980 and 1981. In 1980, investments in "genetic engineering"* accounted for 4.2 percent of the total number of investments but 7.6 percent of the dollars invested. In 1981, "genetic engineering" accounted for 6.2 percent of the number of investments but absorbed 11.2 percent of venture dollars. The disproportionately large average size of "genetic engineering" investments reflects the fact that a large amount of funds must be dedicated to R&D before a concept is proven. In other high-technology industries, "seed money" is usually sought to prove a concept and averages around $1 million per project. But in biotechnology, seed money and startup financing from venture capitalists is generally combined to obtain enough money for product development and initial marketing. Financing for biotechnology projects averaged about $2.2 million per project in 1982 (27). As shown in table 45, seed money is a very small percentage of total venture capital disbursements in the United States, In biotechnology, venture investments have tended to combine both seed and startup financing, making the average disbursement disproportionately high.

The peak period for raising venture capital in biotechnology in the United States occurred in 1980. That year, the valuations of NBFs ranged from $5 million to $25 million for 25 percent of the company (41). The stock market decline of 1981-82 was accompanied by changes in the venture capital market with respect to biotechnology ventures. Valuations of NBFs ranging from $2 mil-

*A definition of "genetic engineering" was not given by the *Venture Capital Journal*

Table 44.—Distribution of Venture Capital Disbursements in the United States by Industry, 1980 and 1981

	Percent of total number of investments		Percent of dollar amount invested	
	1980	*1981*	1980	*1981*
Communications	11.5 "/0	11.4 "/0	10.9 "/0	11.2 "/0
Computer related	27.4	30.0	25.7	34.3
Other electronics related	9.6	14.5	9.6	13.1
Genetic engineering	4.2	6.2	7.6	11.2
Medical/Health related	10.5	7.0	9.3	5.8
Energy	8.3	4.9	19.9	5.8
Consumer related	7,5	4.9	3.7	1.9
Industrial automation	4.5	6.2	2.7	5.3
Industrial products	3.6	4.4	2.0	3.4
Other	12.9	10.5	8.6	8.0
Total	1OO.O"/o	100.0 "/0	100.OYO	100.0 "/0

SOURCE *Venture* Capital *Journa/* 22(6)8, June 1982

Table 45.—Distribution of Venture Capital Disbursements in the United States by Stage of Investment, 1981

State of investment	Percent of number of investments		Percent of dollar amount of investments		Average size of venture financing
	Venture development	Total activity	Venture development	Total activity	($000)
Seed	4"/0		2"/0		$1,000
Startup	26		31		2,200
Other early stage	19		19		2,000
Total early stage	49 "/0	39 "/0	520/o	460/o	$2,000
Expansion	51	40	48	41	$1,750
Total	100%0	79 "/0	100YO	87°/0	$1,900
Other		10 "/0		80/0	1,850
Stage unrecorded		11		5	900
Total		100"!0		100 "/0	

SOURCE *Venture* Capital *Journal* 22(6):9, June 1962

lion to $4 million for 40 to 50 percent of the company became more common. The following two factors may have accounted for the decrease in the valuation of NBFs in 1981 and 1982:

- increased investor knowledge of the time that would be required for commercializing applications of biotechnology, and
- decreased investor interest in biotechnology because most venture capitalists who desired to invest in an NBF had already done so.

At least one venture capitalist stated that the number of new proposals based on biotechnology decreased substantially from 1981 to 1982 (27). Possible reasons for the decrease in proposals include the following:

- the existence of many competing companies in each of the major application areas discouraged additional entrants, and
- the fact that many of the scientist/entrepreneurs who wanted to form a new firm had already done so.

Table 46 shows the cost of venture capital for selected NBFs in the United States, although it should be noted that few general rules can be determined from this table. Genentech and Hybritech, which the venture capital firm Kleiner, Perkins, Caulfield, and Byer partly organized as well as financed, turned out to be particularly good investments. For Hybritech, a $300,000 investment initially purchased 72 percent of the company at a price of $0.20 per share. At the time of the public offering at $26.75 per share, Kleiner, Perkins, Caulfield, and Byer held 29.3 percent of Hybritech worth $1,7 million. For Genentech, a $200,000 investment eventually equated to 14.3 percent of the common stock ($0.21 share cost) worth around $33 million at the time of the public offering. Wilmington Securities, a later investor in Genentech, purchased 6.2 percent of the company for $500,000 or $2 per share of a stock that went public at $35. Lubrizol, a still later investor in Genentech, paid $10 million for 24 percent of the company or $6.43 per share.

Table 47 contrasts the private valuations and public (market) valuations of some recently offered NBF issues. Hybridoma Sciences exhibits the greatest increase in valuation (and thus the highest rate of return to original investors) in the shortest period of time-over 1,100 percent in just over 2 years.

The four sources of venture capital in the United States, which were mentioned at the beginning of this section, are discussed further below. Independent private venture capital funds have accounted for an increasing share of total venture capital relative to that provided by corporate investors and SBICS, as shown in table 48,

Corporate venture capital. A number of major corporations provide revenue to NBFs through R&D contracts as well as equity investments and joint ventures. Contractual relationships provide benefits to the corporate investors as well as the NBF. ***Chapter 4: Firms Commercializing Biotech -***

Table 46.—Cost of Venture Capital for Selected New Biotechnology Firms in the United States

	Private venture capital			
New biotechnolocw firm	Venture capital invested	Percent of company purchased	Price per share	Price per share in public offering
Cetus:				$23.00
1st stage	$ 1,999,600	16.5°\o	$0.91	
SOCal—2d round	5,000,000	10,4	3.60	
Genentech:				35.00
Wilmington Securities, early stage	500,000	6.2	2.00	
Lubrizol	10,000,000	24.0	6,43	
Genetic Systems	200,000	9.7	0,51	6.00
Hybritech	300,000	72.0	0.20	26.75
Molecular Genetics:				9.00
Founders	40,560	59.9	0.02	
Sale of 632,366 shares to American Cyanamid	2,750,000	18.7	4.35	
Monoclinal Antibodies	825,116	29.2	0.52	10.00

SOURCE Off Ice of Technology Assessment, based on information from company prospectuses.

Table 47.—Comparison of Private and Public (Market) Valuations of Eight New Biotechnology Firms With Initial Public Offering in 1983 (millions of dollars except offering price per share)

New biotechnology firm	Date company founded	Private valuation[a]	Date of initial public offering	Public valuation: Offering price and millions of shares offered	Public valuation: Total market valuation and millions of shares outstanding	Ratio of private valuation to public valuation
Amgen	1980	$54—Feb. 1981	6/17/83	$18 2.35	$187 10.4	1:3.5
Advanced Genetic Sciences	3/79	$48—April 1981	7/83	$20[b] 2.0	$242[b] 12.2	1:5
Biogen	1978	$100—April 1981	3/83	$23 2.5	$425 18.5	1:4.25
Cambridge Bioscience	3/81	$8.3—July 1982	3/31/83	$ 5 1.0	$ 20.3 4.08	1:2.4
Chiron	5/81	$29—April 1983	8/83	$12 1.5	$ 87.6 7.3	1:3
Hybridoma Sciences	4/81	$2.2—Feb. 1983	8/83[b]	$ 6[c] 0.70	$ 25.7 4.29	1:11.7
Immunex	7/81	$10.5—July 1982	7/[illegible]/83	$11 1.65	$ 64.3 5.85	1:6.1
Integrated Genetics	1981	$33.3—Dec. 1982	7/19/83	$13 1.6	$107.9 8.3	1:3.2

[a]Based on most recent transaction.
[b]Estimated
[c]One unit. One unit = three shares common stock and three Class A Warrants.

Office Technology Assessment, adapted from E. F. Hutton, prepared July 18, 1983.

Table 48.—U.S. Venture Capital Pool, 1977 and 1982 (millions of dollars)

	1977	Percent of total	1982	Percent of total
Independent private funds and venture capital partnerships	$ 887	35 "/0	$4,400	580/o
SBICs (exclusive of nonventure capital related SBICs)	612	24	1,300	17
Corporate (financial and industrial subsidiaries and non-SBIC public funds)	1,022	41	1,900	25
Total pool	$2,521	100 "/0	$7,600	100 "/0

SOURCE: *Venture* Capital Journal 22(10)"7, October 1982.

nology provides a discussion of these joint ventures and the costs and benefits accruing to both parties. Table 13 in chapter 4, entitled "Equity Investments in New Biotechnology Firms by U.S. Established Companies, 1977-1983,'" summarizes established U.S. firm equity investments in and joint equity ventures with NBFs.

R&D limited partnerships. R&D limited partnerships, consisting of at least one general and one limited partner, are a financing mechanism that allows businesses to engage in research activities without paying for the activities out of retained earnings or borrowed capital. * Most of the 300 to 400 R&D limited partnerships that exist in the United States have been formed since 1980 (29).

From August 1982 to May 1983, over $200 million was raised through R&D limited partnerships by NBFs alone (4). One analyst estimates that R&D limited partnerships will raise a total of $5oo million in 1983 (3). In R&D limited partnerships in biotechnology, the NBF typically serves as the general partner and assumes liability. The limited partners are the investors whose money buys a share of the partnership's future profits or losses. The liability of the limited partners is limited to the loss of their investment. More than 10 R&D limited partnerships in biotechnology have been formed since 1980, and 10 to 20 more are now being formed (40).

Such partnerships have enabled NBFs to reduce their reliance for financing on established companies and venture capital firms and to reduce their costs of capital. They have also provided many NBFs with a stable source of financing for the next 4 to 5 years—the time frame written into most of the partnerships. In other words, R&D limited partnerships are providing NBFs with the financial ability to undertake their own proprietary research and early product development and in some cases clinical testing without relying on established companies and venture capital firms.

As shown in table 49, the total amount raised by 12 NBFs for R&D limited partnerships in biotechnology exceeds $4oo million. The amount raised for each partnership ranged from just under $1 million (Neogen) to $80 million (Cetus). The first NBF to raise a fairly large amount of money ($55 million) through an R&D limited partnership was Agrigenetics. Genentech, which is using an R&D limited partnership as a novel approach to financing clinical trials of human growth hormone and gamma interferon, raised

Table 49.—R&D Limited Partnerships Used by 12 New Biotechnology Firms in the United States

New biotechnology firm	Partnership formation date	Amount (millions of dollars)
Agrigenetics	1981	$55.0
Genetic Systems	1982	3.4
Cetus	1982	80.0
California Biotechnology.	1982	27.5
Genentech	1982	55.0
Molecular Genetics	1982	11.1
Neogen	1982	0.96
Hybritech	1982	7.5
Cetus	1983	78.0
Genentech	1983	34.0
Genetics Institute.	1983a	25.0
Serono Labs	1983	29.0
Total		$405.46

a As of &83 not yet closed.

SOURCE: Office of Technology Assessment, based on information from the trade press and company reports

● The U.S. Supreme Court decision in the 1974 precendent-setting *Snow* v. *Commissioner* (416 U.S. 500) held that limited partners could offset their other income with partnership research or other experimental expenditures. It also extended the reach of section 174 (Title 26 U. SC. IRS §174) to include businesses that had not yet offered any products for sale.

$34 million (27). R&D limited partnerships can provide more financing than the average amount raised by NBFs in the most recent initial public stock offerings (see below).

One advantage to the general partner in an R&D limited partnership is the fact that partnership funds appear on the corporate balance sheet as contract revenue rather than as debt or equity, thus enhancing future investment prospects. Another advantage for the general partner is that the limited partners do not participate in the management of the partnership; in this respect, an R&D limited partnership is unlike other forms of equity financing where investors may sit on the board of directors and shareholders vote on major management decisions.

The limited partner (investor) in an R&D limited partnership is generally interested in investing in such a partnership because R&D limited partnerships, unlike corporations, are treated under the U.S. Internal Revenue Service (IRS) Code as nontaxable entities, meaning that partnership profits and losses are "passed through" to the individual partners who then combine them with their other items of income and expense. * Since an R&D project typically generates tax losses in its initial years (because of large R&D expenditures), limited partners can use those losses immediately to offset other income which might be taxable at rates as high as 70 percent. Furthermore, partners can deduct as much as 85 to 95 percent of their initial investment, immediately decreasing their after-tax cost (and risk) and more than doubling the potential rate of return.

Venture capital funds. Venture capital funds are professionally managed funds dedicated to investment in one or more industries. Sources of capital for these funds include pension funds (e.g., John Deere, General Electric, and Ohio Public Employees Retirement Fund), insurance companies (e.g., Wausau Insurance, Prudential Life, and Metropolitan Life), trust departments of commercial banks such as Morgan Stanley or City Bank, and corporate investors interested in potential profit from discoveries arising from the fund's support.

Of interest is the fact that a few independent private venture capital funds have been formed to invest a significant percentage of their funds in biotechnology. One example is Plant Resources Venture Fund, a $15 million to $20 million fund that invests in companies doing plant-related R&D. In the first 18 months of its operation, this fund invested in three companies, taking all the outside equity in each. Two of the companies are engaged in tissue culture research and the other is a plant genetics company. The strategy of the Plant Resources Venture Fund is to invest $5000,000 to $1.75 million in each company in several stages. In first-stage financing, the fund expects to assume the major share of investment. In subsequent financing, the fund will take progressively smaller amounts as other investors are brought in. Plant Resources Venture Fund anticipates financing another seven to nine companies by 1984 (10).

Small ***Business Investment Corporations. In 1982,*** approximately 17 percent of the venture capital funds in the United States were raised by SBICS. SBICS are private companies licensed by the Small Business Administration (SBA) that must invest their funds in U.S. small businesses. There are three major groups of SBICS: 1) bank affiliates, 2) subsidiaries of venture capital and other financial companies, and 3) independent SBICS and units of nonfinancial companies. Each SBIC must have paid-in equity capital contributed by shareholders of at least $500,000. After the paid-in capital requirement is met, SBA will loan up to three times the paid-in amount of capital, thus extending the resources of the SBIC. In effect, SBICS leverage their paid-in capital by four times with SBA'S assistance. SBICS obtain funds from SBA at very favorable interest rates, several points below the prime rate. They then lend the money to small businesses at a rate that is higher than the rate at which they have obtained it but still less than the prevailing rate.

An SBIC provides at least three kinds of tax advantages for shareholders (34). First, a loss on the sale or exchange of the stock can be treated by stockholders as an ordinary loss, i.e., such loss does not have to be offset against gains from sales of stock, and it can be regarded as a business loss for net operating loss deduction purposes. Second, a loss on the sale or exchange of convertible debentures purchased from small businesses (or stock obtained through conversion) can be

*Corporate profits, by contrast, are taxed both at the corporate and the shareholder level, and deductions for losses incurred by the corporation are not available to the individual shareholders.

treated by the company as an ordinary loss. Third, rather than the normal 85-percent deduction for dividends received from domestic corporations, the company gets a 100-percent dividends received deduction. *

For NBFs that might want to use funds from SBICS, there are two problems. First, because SBICS obtain much of their money as loans from SBA and must repay the SBA in a prescribed period of time, SBICS lend their money rather than use it to buy stock in small businesses. However, an increasing number of equity investments are being made by SBIC bank affiliates such as First Capital Corp. of Chicago. Most NBFs do not seek money from SBICS, because such firms need to retain dollars internally rather than use them to pay interest on debt to an SBIC. Second, SBICS do not generally commit public funds guaranteed by public institutions to high-risk ventures, which is exactly what NBFs are. However, in spite of the interest risks associated with investments in new high-technology firms, some SBICS have invested in NBFs. SBICS raised $4,108,197 in capital for NBFs in 1981 and $3,383,333 in 1982 (50). " They invested in 15 NBFs in 1981 and 9 NBFs in 1982. Thus, although the total amount of capital invested by SBICS decreased from 1981 to 1982, the average amount of capital invested per company increased.

public Stock Offerings .—Public offerings can be divided into initial public offerings, the first time a firm attempts to raise money by offering shares in itself to the public, and subsequent public offerings, when the firm returns to the market to raise additional funds. As a way to obtain funds, the initial public offering differs in an important way from the other methods for raising funds that have already been discussed. The initial public offering is the first time that the firm must publicly disclose its financial and product development status. Going public also requires registration with an oversight organization, the Securities and Exchange Commission, and commits the firm to continued public scrutiny through publicly available reports to shareholders and annual statements to the Securities and Exchange Commission (Form 10-K). Meeting the requirements for public accountability is expensive, both in time and money, and meeting the earnings expectations of the investors can inhibit long-term R&D. In confirmation, Gabriel Schmergel of Genetics Institute in Boston says "reasons why companies haven't gone public is because sometimes they are under great pressure to produce earnings" (18). Thus, although a great deal of money can be raised in a public offering, its costs, both fiscal and otherwise, must also be considered.

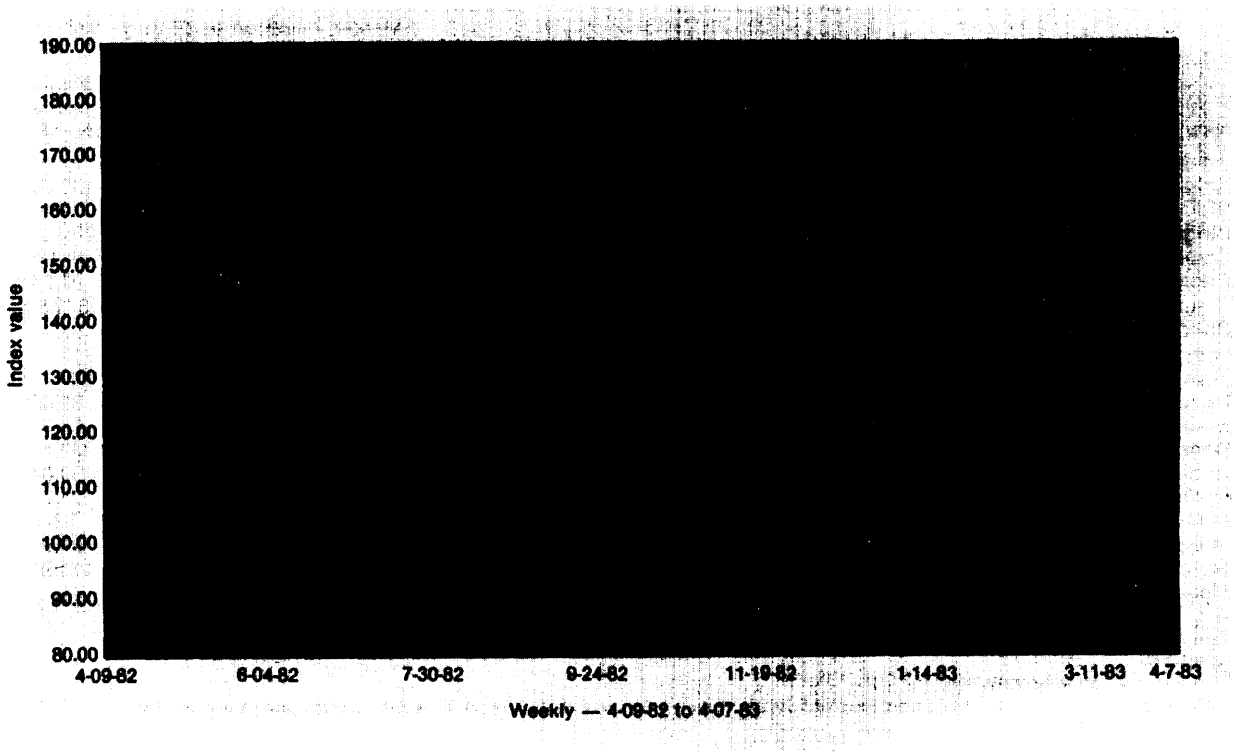
The amount that a firm can raise through a public offering depends not only on the performance of the firm itself but also on the stock market and the receptiveness of investors, In times of recession, institutional investors tend to undervalue high-technology stocks because they are interested in short-term gains (16). Yet, during the early 1980's, despite the recession, high-technology issues were fairly successful, with the peak years for biotechnology stocks being 1980 and 1981. In 1982, some NBFs that made public offerings were not able to raise as much as they had expected. Until September of 1982, the performance of biotechnology stocks paraleled that of Standard and Poor stocks. After September, however, the biotechnology stocks outperformed the Standard and Poor stocks, Thus far, the 1983 bull market has been accompanied by a boom in new issues, greater in magnitude and scale than ever before. For biotechnology issues, 1983 is a banner year. Between March and July of 1983, 23 NBFs raised about $450 million (18). Figure 30 provides a comparative market performance of some MAb, rDNA, and biotechnology support companies with the Standard and Poor 500 for the period April 1982 through April 1983..

During the 1970's, venture capitalists were accustomed to waiting 5 to 7 years before seeing their investments achieve liquidity in the public markets. With the advent of the microprocessor, a number of electronic companies developed applications that became profitable quickly. In some cases, these companies were able to achieve profitability in 18 months and a public offering within 2 to 3 years from founding, in part because of better capital markets after 1978 (8). As a result,

* A corporation pays tax on dividends distributed. The dividend is also taxed as part of income of the distribute. To partially compensate for this double taxation, if the distribute is a corporation, 85 percent of dividends received is excluded from this second taxation. However, if the corporation is an SBIC, 100 percent of dividends received is excluded.

*The 1982 figures available from the SBA did not include November and December figures,

Figure 30.—Comparative Market Performance: Companies Using Biotechnology vs. Standard and Poor's 500 Companies, April 1982 through April 1983



[a]Biotech index includes A. B, Fortia Bioresponse, Cetus, Damon, Enzo-Biochem, Flow-General, Genentech, Genetic Systems, Hybritech, Monoclinal Antibodies, Novo Industri A/S. OTA did not include A. B, Fortia or Flow General as companies using biotechnology.
[b]Standard and Poor's 500 is an index of a broad cross section of companies traded on American stock exchanges.

SOURCE. Off Ice of Technology Assessment, adapted from E F Hutton

some venture capitalists may have shortened their investment time horizons (41), a development that now might be affecting the time taken to bring NBFs to the public market. Table 50 shows the elapsed time between company founding date and initial public offering for 19 NBFs.

The number of, and the amount of money raised in, initial public offerings in all industrial sectors in the United States over the past 10 years is shown in table 51. As can be seen, both the number of offerings and the amount raised first decreased and then increased dramatically. The years 1981 and 1982 were record years for new stock offerings, both in the number of offerings and in the amount raised (though the total amount raised in 1982 was 25 percent less than the amount raised in 1981). Not since the boom of the late 1960's, however, has the new issues market been as active as in 1983.

The initial public offering history and market valuations as of July 1983 for 19 NBFs is shown in table 50. No NBFs made offerings prior to 1980. Two firms went public in 1980, five in 1981, and three in 1982; as of August 1, nine had gone public in 1983. The drop in the number of biotechnology public offerings between 1981 and 1982 parallels the drop in initial public offerings in all sectors during the same period (table 51).

The first recognized "biotechnology firm" to go public, in October 1979, was BioResponse)* with an offering of 1,320,000 units* * at $2.50 per share. Thus, the total raised was $3.3 million. It is interesting to note that at the time of the initial public offering, BioResponse had no revenues and a negative net worth of more than $600,000.

"BioResponse was founded in 1972 and is not included here as an NBF.

* "one unit = one share of common stock plus one warrant

Table 50.—Initial Public Offering History and Market Valuations as of July 1983 for 19 New Biotechnology Firms in the United States

New biotechnology firm	Date company founded	Date of initial public offering	Market valuation as of July 1983: Millions of shares outstanding	Market valuation as of July 1983: Price per share as of 7/15/83	Market valuation as of July 1983: Market value (millions of dollars)
Advanced Genetic Sciences	1979	7183	12.2	N/A[a]	NIA
Amgen	1980	7183	10.0	$133/8	133.75
BioCell Technology	1980	8/81	NIA	1/2	NIA
Biogen	1978	3183	18.5	153/4	291.375
Cambridge Bioscience	1981	4183	4.08	11314	48.175
Centocor	1979	12/82	5.3	17 1/2	92.75
Cetus	1971	3/81	22.0	17 1/4	379.5
Chiron[a]	1981	8183	7.28	12[b]	87.4
Damon Biotech	1983	6/83	19.5	16	312
Enzo Biochem[c]	1976	6/80	5.8	30	174
Genentech[c]	1976	10l8O	1.4	46314	65.45
Genetic Systems	1980	6/81	1.8	14	25.2
Genex	1977	9182	12.6	19	239.4
Hybritech	1978	10I81	10.3	27 1/4	280.67
Hybridoma Sciences	1981	8183	4.29	6[b,d]	25.7
Immunex	1981	7183	5.7	13 1/4	7.5
Integrated Genetics	1981	6/83	8.3	13	107.9
Molecular Genetics	1979	4/82	6.13	18314	114.94
Monoclinal Antibodies	1979	8181	2.4	18314	45

aN,A—information not availabie.
[b]Afterpubiic offering August 1983,
[c]Stock split.
'One unit = 3 shares common stock + 3Ciass A Warrants.

SOURCE Office of Technology Assessment, adapted from E,F. Hutton &Co. inc. Washington, D.C. personal communication, August 1983

Table51 .—Number of Initial Public Offerings and Amount Raised in All Industrial Sectors in the United States, 1972.83

Year	Number of initial public offerings	Amount raised[a] (millions of dollars)
1972	568	$2,700
1973	100	330
1974	15	51
1975	15	265
1976	34	234
1977	40	153
1978	45	249
1979	81	506
1980	237	1,400
1981	448	3,200
1982[b]	222	1,470
1983[a,b]	516	7,900

a Through August 1983.
[b]Howard ACo., Philadelphia, personal communication 1983.

SOURCE Office of TechnologyAssessment, adapted fromK Farrell, ''Going Pubbc 1982,'' ~ent~re, April 1982, p 30

No revenues had been recorded by September 1982 (27), yet stock in BioResponse is trading in 1983 at about $13 per share. The successful experience of BioResponse established a precedent for bringing NBFs with similar financial characteristics to the market.

The history of the initial public offering of BioResponse illustrates the extraordinary investor interest in firms commercializing biotechnology. lndeed, biotechnology has produced two''firsts"on Wall Street. In 1980,Genentech set a new record with a price rise from $35 to $89 per share in the first 20 miqnutes of trading in its initial public offering. In 1981, Cetus set anew high for an initial public offering-$120 million (net amount was $107 million). Even in 1983, the best year ever for raising money for biotechnology, few products had been introduced.

Public offerings in 1982 were less successful than had been hoped for, probably because of an increasing realization by the public that the fruits of biotechnology R&D might be more distant than was first anticipated and also because the stock market was depressed in 1982. Thus, Collaborative Research in February of 1982 raised less than half of the $28.5 million it had hoped to raise in its initial public offering, while Molecular Genetics obtained only $3.3 million, less than one-third of its goal. Genex, in a 2.5 million share initial offering, sought to raise about $30 million to sup-

port scale-up of its research products, but first day over-the-counter sales totaled only about 1 million shares, and the closing price was $9 rather than the $10 to $12 initially predicted.

The boom in the 1983 public offerings market has provided many new firms including NBFs, with capital. Venture capital for NBFs increasingly difficult to obtain, the result being that public offerings in 1983 are supplying second- and third-round financing. NBFs that are either seeking or already have raised second- and third-round financing in 1983 include Cambridge Bioscience, Damon Biotech, Molecular Genetics, Biotechnica, Genetics Institute, Biogen, Integrated Genetics, Applied BioSystems, California Biotechnology/Synergen, DNA Plant Technology, Amgen, Hybridoma Sciences, INGENE, Advanced Genetic Sciences, Biotechnology General, Immunex, and Chiron. Table 52 lists some recent initial public offerings by NBFs and the amounts raised.

The price/earnings ratios for NBFs appear high in 1983, given their negative or low earnings records. Continued reliance on the public market for funds will place increased pressure on public NBFs to earn a profitable income stream quickly. If products are not manufactured and income generated within the time frame demanded by investors in the stock market, NBFs will face additional financial constraints. If they have to rely on the stock market and R&D limited partnerships for funds, NBFs might face problems in financing the long-term risky research in scale-up processes that is needed to commercialize biotechnology products.

ESTABLISHED COMPANIES

Established U.S. companies like Eli Lilly, DuPont, and Monsanto can finance their entry into biotechnology using internal funds generated from a variety of sources, (e.g., the sale of products, interest income on capital, and other sources). Such companies also have ready access to debt financing (e.g., loans) or through debt offerings and the sale of bonds. The cost of borrowing is less for established companies than for new companies, because financing is available to established companies at or near the prime rate. Those NBFs that are able to qualify for loans may pay 2 or 3 percentage points over the prime rate (27). In sum, for established US. companies considering commercial applications of biotechnology, the question is not whether financing is available, but whether or not to spend their sizable resources (or those that they borrow) on the new commercial pursuits of biotechnology.

To illustrate the magnitude of established company resources to enter biotechnology, a few examples can be noted. In 1981, DuPont budgeted $120 million for biotechnology R&D out of a total R&D budget of $570 million (19). In 1982, DuPont began construction of a new $85 million life sciences center, and it acquired New England Nuclear (U. S.) for $340 million, in part to expand its capability in the life sciences. As another exam-p]e, in 1984, Eli Lilly expects to complete a $60 million research center that will emphasize rDNA and immunological applications of biotechnology (13). The annual R&D budgets of established U.S. companies such as DuPont and Eli Lilly dwarf the

Table 52.—Amounts Raised in Recent Initial Public Offerings by Six New Biotechnology Firms

New biotechnology firm	Date of initial public offering	Shares offered (in millions)	Offering price per share	Amount raised (millions of dollars)
Amgen	6/83	2.35	$ 18	$42.3
Biogen	3183	2.5	23	57.5
Cambridge Biosciences	3/83	1.0	5	5.00
Chiron	8183	1.5	12	18.0
Immunex	7183	1.65	11	18.15
Integrated Genetics	7183	1.6	13	20.8

SOURCE Off Ice of Technology Assessment, adapted from E F Hutton & Co , Inc , Washington, D C , personal communication, July 18, 1983.

amounts that have been raised by NBFs in the United States in even the most successful public stock offerings. In 1981, for example, the NBF Cetus raised a record breaking $120 million in its initial public offering—a little more than 20 percent of DuPont's annual R&D budget.

Sources and availability of financing for firms in other countries

The sources and availability of financing for companies commercializing biotechnology in Japan, the Federal Republic of Germany, the United Kingdom, Switzerland, and France—the five countries considered the major competitors of the United States in the area of biotechnology-are outlined in the discussion below.

JAPAN

As noted in ***Chapter 4: Firms Commercializing Biotechnology,*** predominantly large established companies are developing biotechnology in Japan. Established companies in Japan, like those in the United States, are able to rely on debt financing or revenues generated from the sale of products and other internal sources of funds to finance their entry in the field of biotechnology.

The industrial and financial structures of Japan are very different from those of the United States and most European countries. In Japan, equity markets are relatively unimportant for allocating capital. Instead of raising capital by sharing equity, Japanese companies continue to favor debt fi - nancing. * The emphasis on personal savings by Japanese families has produced a large pool of funds in banks and postal savings accounts, and these funds are lent to Japanese corporations. Thus, private sector financing of biotechnology in Japan is usually mediated through the banking system.

NBFs, especially prevalent in the United States, and to a lesser extent in the United Kingdom and France, are not found in Japan because of the low level of equity funds there (39). * Public offerings, venture capital, and other equity instruments are of relatively minor importance there. The low level of equity funding available in Japan is illustrated by comparing the over-the-counter securities markets in Japan with those in the United States. About 111 companies are traded on the Japanese market, compared to 13,000 in the United States. Differences in venture capital investments are also indicative of the relative importance of venture capital in the two countries. In 1982, venture capital investments in Japan amounted to about $84 million, whereas those in the United States amounted to $5.8 billion (6). The low level of interest by Japanese investors in venture capital is further shown by the fact that a venture capital firm established in July 1982 by the Daiwa Securities and Long Term Credit Bank was the first venture capital company to be started in 8 years (6).

The Japanese Government has made two efforts to encourage the development of a venture capital industry in Japan. One effort was made by the Ministry of International Trade and Industry (MITI) in the early 1970's but yielded little in the way of results (22). In a resurgence of interest in this area, in 1982, MITI set up an Office of Venture Enterprise Promotion in parallel with the creation of the Office of Biotechnology Promotion (32).

Japan's private sector has recently taken some initiative in developing a source of "venture capital" by pooling corporate resources. The Japan Associated Finance Corporation (JAFCO) is a private venture capital fund that was organized by Nomura Securities Company. One French, three Hong Kong, and 10 Japanese firms are involved in JAFCO, which plans to offer financial help to new businesses until they qualify for listing as a joint stock company. when the firm reaches this stage of maturity, its income gains will be distributed among the partners of the fund accord-

● A majority of Japanese companies commercializing in biotechnology have debt to equity ratios that exceed ***3 (39),*** as compared to U.S. ratios that are generally closer to 1. Although the Japanese figures are biased upwards because of differences in land values and because off-sheet financing is used more frequently in the United States than in Japan, the differences in debt to equity ratios are significant.

"Other reasons for the scarcity of NBFs in Japan are cultural attitudes that discourage entrepreneurism, the rigid separation in Japan between university basic research departments and industry, and Japan's weak basic science base in molecular biology (39), Some of these subjects are addressed in ***Chapter 17: University/Industry Relationships.***

ing to the ratio of the capital contribution of the fund (22).

These new sources of venture capital may or may not succeed in increasing the supply of venture capital in Japan. In any case, the amount of venture capital these sources currently provide is very small when compared to the amount available in the United States.

The one source of "venture capital" that has been very important to the development of biotechnology in Japan is personal loans of sizable amounts by wealthy individuals who are the managers of progressive Japanese companies such as Hayashibara, Suntory, and Green Cross. As entrepreneurial managers, these individuals are very unusual in Japanese history. A venture by Hayashibara for producing interferon with hamsters was possible only because the owner, who owns or controls 12 institutions (hotels, gas stations, and candy manufacturing firms) and does about $150 million worth of business a year, put his capital behind it (51). The diversification by Suntory (a whiskey company) into rDNA research to produce pharmaceuticals was similarly supported. Significantly, Japan's giant pharmaceutical companies were far slower and more bureaucratic in their response to the potential of biotechnology than these newer Japanese more progressive firms.

In fiscal year 1981, a Government-related organization called the Center for Promoting R&D Type Corporations guaranteed approximately $3.7 million (Y 750 million) in loans (a total of 24 loans). Beginning in 1982, the center was to begin making loans as well as guaranteeing other lender's loans. Up until now, however, the Japanese Government has not been a major source of financing for Japanese companies developing biotechnology.

There is no indication that significant funds are being channeled into biotechnology by financial institutions connected with the Japanese Government to make up for the shortage of venture capital. In the past, Government-funded banks like the Japan Development Bank (JDB) lent only to projects that fit into articulated Government policy and were located in Japan. In the past decade, however, private bank loans have expanded to such an extent that they are competitive commercially with the Government financial institutions (39). Certain funds within the JDB loan portfolio are targeted for technology promotion. For the past 4 years, this fund has remained fairly constant at the level of $500 million (Y 100 billion), approximately 10 percent of the total loan portfolio. Loans from the JDB are made at interest rates between 7.5 and 8.4 percent. There is no indication that any of these funds are being channeled into biotechnology.

FEDERAL REPUBLIC OF GERMANY

In the Federal Republic of Germany, nearly all private sector investment in biotechnology has been made by the established pharmaceutical and chemical companies. There is no parallel in the Federal Republic of Germany to the U.S. venture capital industry. Commercial banks provide most of the funds used for industrial expansion, and it is common for such banks in Germany, unlike those in the United States, to have equity participation in companies in which they invest. The West German commercial banking sector is dominated by three banks, and the linkages between the banking and corporate structures are so close that the Monopoly Commission concluded in **1976** that the banks effectively utilize management functions to the detriment of competition (23).

In 1975, a consortium of 28 banks recognized that the German banking system is not conducive to high-risk, innovative, startup firms and formed a venture capital concern called Risk Financing Society (WFG, Deutsche Wagnisfinanzierungs-Gesellschaft) (7). The principal objective of this organization is to aid small and medium-sized firms in commercializing their products. So far, the electronics industry has been the major recipient of WGF funds; biotechnology firms have not yet been of great interest to WFG. Since 1980, WFG has been looking for innovations that could achieve commercial success within 24 months. If this continues to be the criterion for any firm receiving funds from WFG, then it would be surprising if many startup firms in biotechnology were established in the Federal Republic of Germany with WFG funds (23).

UNITED KINGDOM

The present Government of the United Kingdom believes that the successful industrial development of biotechnology depends on private industry. The main source of funds will be the retained earnings of established companies and the capital provided by private financial institutions. The United Kingdom does not have a well-developed venture capital market, and the tax structure in the United Kingdom is not conducive to the formation of risk capital (the capital gains tax rate there is higher than in the United States, as are the marginal income tax rates for higher incomes).

Despite the little direct availability of venture capital, the United Kingdom is providing public and institutional support to encourage the formation of small firms. The Unlisted Securities Market (USM), for example, was formed in 1980 primarily to raise capital for small companies. At the time of its opening, USM had 6 firms; 2 years later, it had a membership of 115 firms and was capitalized at a total of $2 billion. Most of the trading volume in this market is accounted for by small investors. The value of the shares of USM'S 20 largest companies has increased 45 percent over the past 2 years, excluding dividends (43). Before USM was established, companies could be listed only on the London Stock Exchange, and listing there required profits of at least $1 million. In addition, until 1977, the London Stock Exchange required a company to sell off at least 35 percent of its equity for listing (the requirement has since been scaled down to 25 percent).

The British Government has introduced two new measures to encourage the formation of small firms. The first measure is designed to encourage the private sector to make equity investments in startup firms by offering tax relief at the top marginal rate to investors in new (up to 5 years old) qualifying businesses. As a result of this measure, a number of professionally managed funds have been established wherein individuals have pooled their money allowing the professional managers of the fund to make their investments. Cambridge Life Sciences, the first British biotechnology firm to go public, used this measure in April 1982 (43). The second Government measure is to guarantee loans made by banks and other financial institutions for qualifying projects that are considered to be viable (in the institution's judgment) but are not backed by personal securities. This measure means that individuals need not have substantial income in order to form a company.

Views on whether there is a shortage of funds available for biotechnology firms in the United Kingdom vary depending on the source of information. Financial institutions say funds are not in short supply; rather, the shortage is in well-presented ideas with commercial value that are capable of earning the relatively high rates of return desired by investors with risk capital. Entrepreneurs say that there is a shortage of funds because institutions demand more evidence than they can supply to prove that their products are capable of earning high profits.

Several institutions in the United Kingdom are supplying funds for the development of biotechnology, including Biotechnology Investments Ltd., Prutec, Advent Eurofund, Cogent, and Technical Development Capital (43). Biotechnology Investments Ltd., a branch of N.M. Rothschild Asset Management, is the largest, with an initial capital pool of $55 million (17). Although Rothschild has invested mostly in U.S. NBFs and other foreign companies, it recently purchased equity in Celltech (U. K.) and is considering several proposals from other British firms. Another fund, Technical Development Capital (TDC), provides equity financing in addition to loans and has a policy of becoming actively involved in management teams. TDC has an annual budget of $5.7 million (10 million) of which $1.4 million (# 2.5 million) is devoted to biosciences, one of three priority areas. The time scale of investments required depends on the industrial sector (e.g., in the medical field, the time horizon is 5 to 7 years; in agriculture, it is 15 to 20 years), TDC has investments in Celltech, Imperial Biotechnology, and three other NBFs in the United Kingdom. Prutec, a wholly owned subsidiary of the Prudential Assurance Co., Ltd., was established in 1980 and makes investments in technology-based firms. Prutec has identified biotechnology as one of 10 strategic areas for investment.

A public institution, the British Technology Group (BTG), is sponsored by the Department of Industry and is the major public source of venture capital in the United Kingdom. BTG invests a certain percentage of its funds in high-risk, long-term investments. The aim of BTG's investment group is to invest on commercial terms in minority partnership with private industry. The best known example of this policy is BTG's investment in Celltech.

Although the number of NBFs forming in the United Kingdom is increasing, the established firm sector is largely responsible for the development of biotechnology there.

SWITZERLAND

Funding for new, high-risk enterprises in Switzerland is not readily available. Analysts attribute this situation to many factors. The Swiss banking industry is oriented to large-scale international financial transactions in areas such as securities, foreign exchange, and precious metals. The banking expertise to evaluate and finance new technologies is lacking. Some argue that the structure of the savings system is changing, with private savings declining and pension funds, traditionally more conservative in investment policies, increasing. Added to these factors is the national reluctance to take risks. The NBF Biogen S. A., for example, has relied heavily on U.S. venture capital and the U.S. stock market to obtain needed capital to finance operations (24).

All of the established Swiss chemical and pharmaceutical companies have substantial capital investments in the United States. Because of the small size of Switzerland's domestic market, most Swiss companies are multinational. The Swiss companies spend a substantial fraction of their R&D costs abroad (this fraction varies among companies). Ciba-Geigy, for example, traditionally spends about 60 percent of its research expenditures in Switzerland and 40 percent in other countries; in 1981, Ciba-Geigy's expenditures on R&D in the United States rose to 23 percent of its total research expenditures, and expenditures on R&D in Europe and in Asia accounted for 20 percent (24).

FRANCE

The number of companies involved in commercializing biotechnology in France is fairly small, and the Government expects this situation to continue. The French Government, which generally believes that only large companies have the necessary resources to undertake biotechnology, has identified three centers of development in the private sector: Rhone Poulenc, Elf Aquitaine, and Roussel Uclaf. Rhone Poulenc and Elf Aquitaine are now nationalized, and Roussel Uclaf is 40-percent Government owned (44).

The venture capital market is poorly developed in France. Banks are the major source of financing. Banks in France, like their counterparts in the United Kingdom but unlike those in West Germany, have always hesitated to take equity positions in industry. The Government of France would like to change this attitude (28). A mutual guarantee company, INODEV, was established by the French Government to guarantee bank credit for the purpose of innovation (33). Since French banks do provide long-term financing, French firms do not have to worry as much about second- and third-round financing as do firms in the United States (44).

Tax incentives relevant to firms commercializing biotechnology

The various tax provisions in the United States, Japan, and Western Europe that are potentially important to companies commercializing biotechnology * are those pertaining to R&D expenditures, capital formation, corporate taxation, and tax treatment of small businesses. * * A summary of the tax provisions described for the United States, Japan, the Federal Republic of Germany, the United Kingdom, and France is presented in table 53. Switzerland is excluded from the table, because Swiss tax rates vary among cantons, and the Federal tax system is less important.***

U.S. tax provisions affect NBFs and established companies differentially. In order for corporate tax rates to make a difference in the decisionmaking process of firms, taxable income, the base on which taxes are figured, must be present. Since the NBFs are not experiencing substantial profits, and because there are loss carry-forward provisions in the tax code (for the United States, the period that a company can carry forward losses is 7 years), most NBFs are not now focusing a lot of attention on tax incentives, * Established companies earning taxable income from a number of product lines, by contrast, are interested in current tax benefits.

In a recent study of California biotechnology companies, few participants in the survey stated that tax abatement programs would be useful to their companies (16). Tax abatement programs were rated on a scale of possible utility to the company; evaluations of these programs by the executives responding to the survey ranged from "possible" (at best) to "unlikely." This pattern may reflect the essentially entrepreneurial nature of the NBFs included in the survey. The more established firms with a diversity of product lines would be more interested in tax incentives not primarily focused towards capital formation. It may happen that as established companies become more important in the field, tax incentive programs will be viewed with more interest.

It is important to note that some countries rely more on tax provisions to stimulate capital formation or industrial development than others that use grants or subsidies to assist specific industrial projects. The United States, Switzerland, and to a lesser extent the United Kingdom, for example, tend to rely more on tax incentives to encourage overall capital formation than, for example, the Federal Republic of Germany or France, which use grants or subsidies for specific projects. Other countries (e.g., the United Kingdom, France, and Japan) use tax incentives to encourage investment in R&D or plant and equipment required for scale-up or scientific research, Furthermore, some countries (e.g., the United States and Japan) favor formation of small businesses by tax provisions that are specifically aimed at smaller establishments. Japan targets particular industries and uses both tax incentives and grants.

Some analysts state that the tax incentives in the United States, when compared to those in Western Europe, are not a major factor in decisions about the location of foreign subsidiaries of biotechnology companies (26). However, others argue that sharp differences in the corporate tax rate between countries such as the Netherlands Antilles (whose nominal corporate tax rate is 3 percent) and the United States (whose nominal corporate tax rate is 46 percent) have led some

"The tax codes of various countries change frequently. The discussion here is based on the latest information available in existing sources. The intent of this section is to sketch the major provisions, not to detail specifics of each tax code.

" *Local or regional taxes are not included, except in the case of Switzerland, which taxes primarily on a cantonal level. Value-added taxes are also not included, since not all countries have this tax.

•• "In Switzerland, taxes are governed by Federal law and the tax laws of 26 cantons. While the Federal Government collects practically all indirect taxes, it receives only a small portion of direct taxes levied. The 26 Swiss cantons have a number of obligations, which in other countries would be the responsibility of the Central Government, such as education, road construction, health, police, and justice expenses. To be able to meet these obligations, tax revenue is collected from taxes on income and net assets of individuals and business entities by each canton.

● For this analysis, OTA solicited the views of the following companies engaged in biotechnology: Biogen, Cetus, Genex, Genentech, DuPont, Hybritech, and Monoclinal Antibodies. Industrial Biotechnology Association and the U .S, Department of Commerce were also contacted. Most stated that tax incentives are of secondary importance to other tax provisions (e.g., loss carry forward provisions, R&D limited partnership, and capital gains treatment) given the stage of the company's development,

Table 53.—Tax Treatment of Innovation Activities in the United States and Other Countries

Capttal expenditures for R&D	Current expenditures for R&D	Venture capital investments in new technology-based firms	Small business tax treatment	R&D tax credltsl Investment grants[a]
United States:				
Treated in same manner as other depreciable assets	Immediately expensed	R&D limited tax partnerships allow investors to write off current expenses as losses and treat future gains as capital gains Investors can pool funds in a regulated investment company of which venture capital corporations are a member, and the company can avoid taxes if the company distributes all its income	SBIC treatment: 1) dividends-received deduction of 100/0 is allowed to SBICS for dividends received from taxable domestic corporations; 2) loss on stock is treated as an ordinary loss and does not have to be offset against gains from sales of stocks; 3) gains are treated as capital gains Subchapter S corporations: A sub S company gives owners of closely held corporations the advantage of limited liability for depts while taxing the corporation's income at shareholder's income rates. Number of shareholders permitted is 35	Can deduct 25% of the difference between the current year's R&D expenditures and the moving average of a 3-year period.
Japan:				
Firms that are members of Research Association can take 100°/0 depreciation allowance on all fixed assets used in connection with Research Association activities	Immediately expensed	No special provisions	The cort)orate tax rate for small-and medium-sized corporations on the first + 7 million ($28,107) is 22°/0 (as opposed to regular rate of 300/0). A small business can add each year to the ordinary depreciation allowance up to 14Y0 of the original value of new equipment and machinery acquired between Apr. 1, 1972 and Mar. 31, 1983 Additional depreciation allowances are allowed for small businesses that are entering new industries.	Can deduct each year from its income tax 20°/0 of the difference between the current year's R&D expenditures and the highest R&D expenditures in a year before the current year if the difference is positive
Federal Republic of Germany:				
Det)reciated in same way as other assets. For expenditu~es of plant and equipment embodying new technology, the depreciation allowance includes reasonable allowance for obsolescence	Immediately expensed No	special corporate tax treatment for" venture capital investments	There is no special corporate tax treatment apart from a provision applicable to foundations and associations. For these organizations, there is a deductible tax free amount of DM5,000 (U.S. $2,060). If corporate income exceeds DM1O,OOO ($4,120), the tax-free amount is reduced by half the excess	Investment grant of 200/0 of cost can be claimed for the first DM500,000 (U.S. $206,049) of the costs of assets used in R&D. The excess of cost DM500,000 qualifies for an investment grant of T.S°/o
United Kingdom:				
For scientific research assets, a 100°/0 tax allowance (or deduction) is given. Allowances are given for capital expenditures (e.g., labs) and current expenditures (e.g., research workers' salaries)	Immediately expensed.	No special tax provisions for venture capital investments	A closely held company's investment income is apportioned, provided it is surplus to the requirements of the business. Corporation tax rate is 400/0 if profits do not exceed ~' 70,000 (U.S. $122,527)	—

Table 53.—Tax Treatment of Innovation Activities in the United States and Other Countries (Continued)

Capital expenditures for R&D	Current expenditures for R&D	Venture capital investments in new technology-based firms	Small business tax treatment	Fi&D tax creditsl investment grants[a]
France:				
Can depreciate 50°/0 of the cost in first year with the balance depreciable over useful life	Current expenditures are immediately expensed—carry-backs are not allowed	Businesses which purchase shares in Qualified Research Companies and shares in Innovation Finance Companies may deduct 500/. of the cost of the shares in the year of acquisition. If shares are sold, the additional gain attributable to this 50°/0 deduction is eligible for capital gains tax treatment. If shares are held for 3 years or more, no capital gains tax is assessed	Small and medium-sized businesses (fewer than 2,000 employees, not legally dependent on a larger business and having less than 500/. of their shares held by quoted companics) are entitled to an exceptlonal deduction of 50°/0 of the cost of equipment and tools used for R&D Tax allowance amounting to one-third of the firm's taxable profits in the fiscal years of its establishment and in the 3 subsequent tax years	—

[a] Information on the tax rules of foreign countries obtained from tax serwces and other secondary sources, not from the foreign statutes themselves While efforts were made to obtain accurate and up-to-date Information, It should be noted that reliance on secondary sources does Increase the potential for error

SOURCE Off Ice of Technology Assessment, based on information from National Science Foundation, *Corporaf/on Income Tax Treatment of /rrvestrnent and Innovation Act/v/f/es In Six Counfr/es,* Washington, D.C , 1981, Price Waterhouse & Co , *Price Waterhouse Information Gwde" Do/rrg i3us/rress In Germany,* September 1978, Price Waterhouse & Co , *Price Waterhouse /n format/on Gwde Do/rrg Business In France,* 1979, Price Waterhouse & Co , *Price Waterhouse /rrforrrrat/on Gwde Do/rig Business In the Unlfed Kingdom,* 1980; and Price Waterhouse & Co *Pr/ce Waterhouse /n formation* Guide Doing *Bwness (n Switzerland. 1982*

biotechnology companies to incorporate in the Netherlands Antilles and then form a subsidiary in the United States (20). Generally, tax incentives aimed at capital formation, such as the R&D lim - ited tax partnership or capital gains tax rate, are viewed with much more interest in the short term by LJ.S. NBFs than tax incentives because NBFS need taxable income to use them.

Tax incentives relevant to new biotechnology firms in the United States and other countries

Tax incentives beneficial to NBFs include R&D tax incentives, capital formation tax incentives, and tax treatment of small businesses.

R&D TAX INCENTIVES

The LJ.S. tax code offers no special incentives for R&D beyond those available for investment generally and for investment in depreciable structures or equipment used for research and experimental design. The buildings used for R&D are not given preferential tax treatment in the United States as they are in Western European nations. Thus, the United States has no special tax incentive for construction of plant or equipment used in biotechnology. Such an incentive may be, depending on the importance of the costs of depreciable assets in the total production costs, an important factor in determining cost competitiveness in biotechnology products. As products move from research to scale-up stages of production, these costs become more important.

Companies in the United Kingdom are entitled to a 100-percent first year writeoff on capital expenditures for scientific research, the most rapid allowance offered by any country (1). Tax provisions allowing the immediate deduction of capital expenditures for assets used in R&D provide a current tax benefit* rather than a deferred tax benefit, because the capital expenditures for R&D may be offset against income earned in the year of the capital asset's acquisition rather than offset against income earned over the useful life of the asset. Accelerated depreciation provides a tax benefit in that it permits a much faster recovery of the cost of an R&D asset; however, the immediate deduction of the total cost of the asset provides an even faster recovery of costs. The Federal Republic of Germany allows accelerated depreciation for R&D assets in the form of additional depreciation taken in the first few years the assets are used. For investments of less than $234,750 (DM570,000), there is an investment grant of 20 percent of the cost of the assets used in R&D (9,30). France allows 50 percent of the cost of buildings used for scientific or technical research to be written off in the first year.

The United States, Japan, the Federal Republic of Germany, the United Kingdom, and France allow deductibility of current R&D expenditures, but only the United States and Japan give a tax credit for incremental R&D. The Japanese tax credit allows a company to deduct each year from its income tax 20 percent of the difference between the current year's R&D expenditures and the highest R&D expenditures in a base year before the current year. The U.S. tax credit allows a company to deduct 25 percent of the difference between the current year's R&D expenditures and the moving average of a 3-year period's R&D expenditures. In order to qualify for the credit, a company must be carrying on a trade or business. The U.S. Treasury was given leeway in defining the trade or business, and it was widely hoped that the newest proposed regulations would give small firms, primarily engaging in research but not yet selling products, an advantage. Some have stated that Treasury's position is inflexible towards the small firms not yet able to produce products (5).

Some analysts argue that the U.S. tax credit for incremental R&D encourages more R&D than Japan's tax credit, because the base used in the United States (the moving 3-year average) may be lower than the base used in Japan (the highest R&D expenditure in a previous year); the lower base in the United States may allow a higher tax credit given the same rate of increase in R&D expenditures. The U.S. tax credit is currently scheduled to expire in 1985, and many are urging an automatic extension of the credit, especially since the planning and implementation of R&D is a long-term process. Legislation introduced in

● This current benefit is of immediate benefit only to firms with sufficient current taxable income to use the tax benefit.

the 98th Congress, H.R. 3031, sponsored by Representative Fortney Stark, and S. 738, sponsored by Senator John Danforth, would amend the IRS Code by making the R&D credit permanent in the United States. France is considering a 25-percent tax credit for R&D expenditures, thus encouraging through the tax system an increase in R&D expenditures (49). Whether the implementation of additional **tax** credits will affect the amount of money devoted **to** R&.D expenditures will depend in part upon the permanency of the tax provision in each country.

The treatment of income derived from the sale or license of technology differs among countries. In the United States, proceeds from the sale of patents are treated as long-term capital gains (taxed at the long-term corporate capital gains tax rate of 28 percent). Royalties are taxed as ordinary income (30). In Japan, both proceeds and royalties are treated as ordinary income. Sales of patent rights, technical and manufacturing processes, and know-how are taxable in France at the reduced 15 percent long-term capital gains tax rate (l). Royalties are taxed at the standard 50-percent corporation tax rate unless industrial property rights have the characteristics of fixed assets or the license is granted for 8 years and for exclusive use within a geographical area. In the latter instances, royalties are taxed as long-term capital gains. In the United Kingdom, any capital sum received on the sale of a patent by a U.K. resident is charged as if it were a corporation (at a tax rate of 52 percent); the sum is generally spread over 6 years, so that one-sixth of the sum is liable to tax in each year. Royahies received are treated as ordinary income (30). Overall, the United Kingdom has the most adverse tax treatment of income resulting from the sale of technology (whether involving the sale of patents or licensing).

CAPITAL FORMATION TAX INCENTIVES

Tax incentives designed to stimulate capital formation are of special importance to the formation and growth of NBFs, because few NBFs have enough income derived from product sales or contract revenue to sustain high costs for both R&D and scale-up production. In affecting the amount of capital available to smaller firms, the tax treatment of individual capital gains and R&D limited partnerships are important.

Tax Treatment of Individual Capital Gains.—The long-term capital gains tax rate for individuals in the United States is 20 percent, down from 49 percent in 1976. Industry analysts suggest that this decrease in the individual capital gains tax rate is the primary reason for the substantial increase in venture capital available in the united States (27).

In Japan, capital gains on the sale of securities are exempt from tax, unless the sales are habitual or in the course of business. For nonexempt gains, the first $2,232 (500,000) is exempt, and the remainder of gain is either taxed as short-term capital gains (treated as ordinary income) or long-term gains (SO percent taxed at ordinary income tax rates) [42).

In the Federal Republic of Germany, no capital gains tax is payable by individuals on assets held longer than 6 months, If an asset is held less than 6 months, the capital gains income is taxed as ordinary income. Capital gains arising from the sale of business assets by an individual are liable to tax at normal rates where the assets form part of the business property. Extraordinary income arising as a result of a gain from the sale of an entire unincorporated business or from the sale of shares by a substantial shareholder are taxed at half the individual's marginal tax rate, i.e., at a maximum of 28 percent (35).

In the United Kingdom, capital gains income is subject to a tax rate of 30 percent (42). The tax treatment of capital gains in France depends on the length of time the asset is held. Short-term capital gains (on assets held for less than 2 years) are included in operating profit and are taxable at a 50-percent tax rate (37). The taxpayer may elect to spread the capital gains tax over 3 years. Long-term capital gains (on assets held for 2 years or more) are taxable at a IS-percent tax rate. Long-term capital gains and losses of the same fiscal year are offset against each other.

Tax Treatment of RdkD Limited Partnerships.—As discussed in the section of this chapter on "Financing in Firms Commercializing Biotechnology)" an important tax tool used for risk

capital formation in the smaller companies engaged in biotechnology in the United States is the R&D limited partnership. Some NBFs using R&D limited partnerships as a method of raising capital have stated that they prefer the partnerships as a method of financing, because the revenues from a partnership are treated as revenues and allow a company to show a profit even if it has few or no products to sell (27). By using R&D limited partnerships, NBFs have postponed issuing stock, selling equity to established firms, or searching for venture capital, thereby keeping more control over their company. Neither Japan nor West European countries use a similar type of tax treatment.

An R&D limited partnership is formed to support R&D that will result in something that is marketable and patentable. As discussed below, financial advantages accrue to the limited partners (investors) at both the R&D phase and the marketing phase, provided certain conditions are met.

Turning attention first to advantages at the R&D phase, the applicable part of the Internal Revenue Service (IRS) Code is section 174 (Title 26 U.S.C. IRS f174). Section 174 allows each limited partner to deduct all expenses for research (generally, the amount the limited partner invested in the partnership) from income in the year the expenses were incurred, provided the limited partners were at risk. * If the limited partners are not at risk, such deduction is not allowed, The challenge, therefore, is to write the agreement establishing the partnership so that the limited partner is at risk, This is generally done by structuring the agreement so that the general partner does not ***automatically*** buy the results of the research from the limited partners. An automatic purchase provision in the agreement would presume the research would be successful and imply that there was no risk. Similarly, agreements usually base any financial return to the limited partners that may arise from the partnership on sales rather than profits, because the term "profits" in the agreement implies success and hence a no-risk situation.

Upon successful completion of an R&D project supported by an R&D limited partnership, the limited partners may realize economic returns either through royalties or license fees derived from the sale or transfer of a patent or by sale of the product back to the general partner or to a third party. Both of these may qualify for favorable tax treatment. If the research results in a patent, the patent may be sold or transferred by the limited partners to the general partner, generally in return for royalties or license fees, Under section 1235 of the IRS Code (Title 26 U.S.C. IRS ~1235), any royalties received as a result of transfer of a patent qualify as long-term capital gain rather than ordinary income. The current tax rate on long-term capital gains for individuals is 20 percent, whereas the tax rate on ordinary income can be as much as 50 percent. The usual l-year period necessary for the sale of a capital asset to qualify for capital gains treatment does not apply.

Generally, section 1235 treatment applies to a transfer of property consisting of all substantial rights to a patent by any holder. A holder is defined as any individual whose efforts created the patentable property or any other individual who has acquired interest in the patentable property in exchange for money paid to the creator prior to the actual reduction to practice of the invention. * This definition of holder makes it difficult for R&D limited partnerships to acquire rights to a patent when a university has the rights to the patent through employment agreements with its university scientists. Universities that have obtained patent rights through employment agreements with university scientists are excluded from the present definition of holder. As a result, relatively few universities have formed R&D limited partnerships as a means for helping to commercialize their research results.

If the research results in nonpatentable know-how or technology, the sale of the property must meet the requirements of sections 1221-1223 or section 1231 of the same IRS code for the proceeds to be taxed to the limited partners ***as capital*** gains rather than ordinary income. Under this

*To ascertain whether the partners bear the required risk, one asks, "Who loses if the research effort is a complete failure?"

"Reduction to practice is a term **used** in patent law referring to when the invention has been tested under operating conditions.

section, capital assets must be held for at least 1 year before they are sold to qualify for long-term capital gains treatment. Another challenge then is to write R&D limited partnerships so that they result in a patent.

Two recent changes in the U.S. tax code have increased investor interest in economic return from tax shelters, rather than just a tax deduction. First, the maximum tax rate on unearned income has been reduced from 70 percent to 50 percent. This reduction in the maximum tax rate makes unearned income for individuals in high tax brackets more valuable than it used to be and also reduces their need to shelter it. Second, investors may no longer deduct more than the amount they are actually at risk; thus, they can no longer recoup more than their full cash investment in tax savings.

There are two potential disadvantages of R&D limited partnerships for the limited partner. The first is low liquidity: the only way for a limited partner to get out of the agreement is to convince the general partner to buy his or her interest in the partnership. The second is that patents are the only assets that qualify for tax treatment under section 1235, other types of intellectual property, such as plant variety protection certif - icates and trade secrets, do not qualify. *

R&D limited partnerships permit the partners to deduct partnership expenses for R&D activities from their individual incomes and then allow any income from the sale of the successfully developed invention to be treated as capital gains income, which is taxed at lower individual tax rates.

Because the financial markets are so dissimilar amoung countries, it is difficult to compare the effect on investments of different capital gains tax treatment. However, the United States has a more developed capital market than its competitors in biotechnology and also has more options for financing smaller firms. If the NBFs continue to serve as an important source of innovation, the expanded financing options for these firms will help the competitive position of the United States. The ability of firms to commercialize innovations will serve as a better indicator of a country's competitiveness than the ability of firms to serve as a source of innovation.

TAX TREATMENT OF SMALL BUSINESSES

Some countries have special tax incentives to promote the growth of small businesses. Studies suggest that small businesses serve as an important source of innovation as well as of the diffusion of technology.

The most favorable tax treatment for smaller businesses is provided by the United States. Subchapter S corporations* give the owners the advantage of limited liability for debts, while the corporation's income is taxed at the shareholder's tax rate rather than at the corporation's tax rate. A key advantage of subchapter S is that if a company generates operating losses, these can be "passed through" to the individual shareholders. The shareholders can use the losses to offset other taxable income. If the owners of a small company have incorporated as a "Sub-S" and they are in the 50-percent tax bracket, then the effect is that the U.S. Treasury is financing 50 percent of the new company expansion. Most NBFs are experiencing losses, so this form of corporation is attractive.

Japan also has special tax treatment for small businesses. A small business can add each year to the ordinary depreciation allowance up to 14 percent of the original value of new machines and equipment. In addition, there is a special depreciation allowance for encouraging small businesses to enter new industrial sectors. A small business that plans to change its business can treat its old machines and equipment as ones newly acquired when it calculates depreciation allowance. Special first-year depreciation credits are now allowed on this machinery (39).

A recent study by the Organisation for Economic Co-Operation and Development (OECD) outlined member government policy towards small businesses and concluded that European countries had fewer policies aimed at small firms than did either the United States or Japan (33).

*"Patent law and plant breeders' rights statutes are discussed in ***Chapter 16: Intellectual Property Law***.

*Any corporation satisfying requirements described in the Subchapter S Act and Subchapter S Revision Act of 1982 is known as a Subchapter S corporation,

The French Government has been giving increasing attention to startup firms since 1976. Three problems for smaller businesses have been addressed: self-financing, external capital financing, and access to medium- and long-term bank credit (33). The first problem is being addressed through a tax allowance for startup firms equal to one-third of the firm's taxable profits in the fiscal year of their establishment and in the 3 subsequent tax years. The usefulness of this incentive for the small firms using biotechnology in its present stage of development is questionable. Few NBFs are experiencing profits, so few wouId be able to use the tax allowance. The second problem, external capital financing, is addressed in France through the establishment of regional financing companies (Societesde Financement Regional) and incentives for these financing companies to acquire holding in new firms. The last problem, access to bank credit, has been and still continues to be a problem for smaller companies in France. As noted earlier, the Government of France has established a mutual guarantee company, INODEV, to guarantee bank credit for the purposes of innovation (33). In addition, small and medium-sized businesses (i.e., businesses that have fewer than 2,000 employees, are not legally dependent on a larger business, and have less than so percent of their shares held by quoted companies) are entitled to an additional deduction of 50 percent of the cost of equipment and tools used in R&D. However, the small firm sector is not expected to play as innovative a role in France as it has in the United States.

In the Federal Republic of Germany, there is no special tax treatment of small businesses other than a provision applicable to research foundations and associations (30),

The United Kingdom has few tax provisions available to investors or owners of small businesses that would encourage the formation of startup firms. To the extent that the NBFs are ***im***portant in determining a country's ability to capture world market share in biotechnology products, the United Kingdom would be at a disadvantage. A U.K. resident company which is controlled by five or fewer persons (a person is defined as an individual and near relatives) or by its directors is known as a close company. There is exemption for certain companies which, although closely controlled, have a 35-percent public shareholding and are quoted on a recognized stock exchange. A close company is subject to special tax provisions, of which the most important before March 26, 1980, was that all or part of the company's undistributed after-tax income, after allowing for certain business requirements, could be apportioned (i.e., attributed to its shareholders according to their respective interests in the company and treated as their income). For accounting periods ending after March 26, 1980, only a close company's investment income can be apportioned (37). Therefore, the income of a close company is, to the extent attributed to shareholders under these provisions, subject to the progressive rates of personal income tax and investment income surcharge. Companies whose pretax profits do not exceed $40,000 (<22,900) pay a corporate tax rate of 40 percent instead of the usual 52 percent (37).

Various countries have national programs of regional tax incentives to encourage industries to develop in particular geographical locations. France is divided into four zones, Zones A through D, for incentive purposes. Zone D is the Paris Basin area and the Lyon region, and for this area, there exist no incentives, The other areas have varying amounts of grants and other incentives available (33), In the United Kingdom, enterprise zones are to be designated to encourage the creation of new businesses in economically declining areas. Generous depreciation allowances will be granted in these areas on the cost of certain new buildings in these zones. There also exist regional tax incentives in the Federal Republic of Germany, but the incentives only apply to the West Berlin area. In the United States, there are no Federal programs to encourage industry development in certain sections of the country. Increasingly, however, local and State governments are offering their own tax incentive programs.

Tax incentives relevant to established companies in the United States and other countries

Tax incentives for established companies include R&D tax incentives, capital formation tax incentives, and corporate taxation.

R&D TAX INCENTIVES

The depreciation allowances that apply to the capital assets used in R&D by established companies are the same as those discussed in the R&D tax incentives section for small firms above. Additional tax incentives for established companies are noted below.

Large established companies in the United States can utilize the same R&D tax credits as those used by small firms. An early assessment of the recent U.S. R&D tax credit suggests that it is not likely to induce significant increases in the growth rate of R&D in the short run, but the tax credit may have been one of a number of factors helping to ***maintain*** R&D budgets in the tight financial situation of 1980-82 (31).

Table 54 shows initial calculations relating U.S. firm size to tax credits earned in 1981. The assumptions underlying this table are: 1) about 63 percent of total R&D budgets is actually eligible for inclusion as R&D expenses for the credit; and 2) half of 1981 eligible expenditures occurred in the second half of the year (because only the second half of 1981 is covered by the credit). The tax credit as a percent of total 1981 R&D falls from about 2 percent on average for firms with fewer than 1,000 employees to about 1 percent for firms with 25,000 employees or more. The inverse relationship between firm size and tax credit as a percentage of R&D reflects the inverse relationship between firm size and rate of growth of R&D. The initial results tend to suggest that the tax credit for R&D is relatively more important to small than large companies.

Japan allows companies that are members of a Government Research Association* such as the one formed for biotechnology research to take a 100-percent depreciation allowance on all fixed assets used in connection with their Research Association activities. Only established companies are members of Research Associations. The Federal Republic of Germany provides a 7.5 percent tax-free cash subsidy for investment in R&D facilities for investments exceeding $206,050 (DM500,000).

Some countries allow businesses to deduct payments to research institutes for contract research. The United Kingdom allows deduction for payments made to research institutes approved by the Secretary of State or the Minister of Technology (1). The United States allows corporations to deduct the cost of equipment given to universities. Also, a manufacturer of new R&D equipment in the United States can donate equipment to universities and obtain a deduction of cost plus one-half the difference between price and cost, up to a limit of twice cost. Payments to universities for contract research or basic research by firms may be included in eligible expenditures for computing R&D tax credit.

CAPITAL FORMATION TAX INCENTIVES

The corporate capital gains tax rate and investment tax credits are discussed below as they relate to capital formation for established compa-

● Research Associations are government-sponsored groups of established companies in Japan performing joint research in specified fields

Table 54.—Estimated Relationship Between Tax Credit Earned and U.S. Firm Size[a]

Number of employees in company	Number of companies	R&D expenditures (millions of dollars) 1980	1981	Change 1980 to 1981	Tax credit as a percent of R&D expenditures
Not available	24	$ 102	$ 130	$ 28	1.460/o
Under 1,000	113	185	240	55	1.91
1,000 to 4,999	286	1,260	1,563	302	1.56
5,000 to 9,999	99	872	1,031	158	1.28
10,000 to 24,999	108	2,781	3,282	500	1.25
25,000 and over	147	22,686	25,862	3,176	0.99
Total	777	$27,886	$32,107	$4,221	1.060/0

a Based on figures published in *Business Week's* **"R&D scoreboard 1981."**

SOURCE. National Science Foundation, *An Earl y Assessment of Three R&D Tax Incenhves Prowded by the Economic Recovery Act of 1981,* PRA repod 83-7, Washington, D C., April 1983

nies. In a broader sense, all of the tax incentives discussed in this chapter have some influence on companies' decisions concerning investment.

Corporate long-term capital gains are taxed in the United States at a maximum rate of 28 percent. In the Federal Republic of Germany and Japan, corporate capital gains are taxed at ordinary corporate income tax rates. In the United Kingdom, corporate long-term capital gains are effectively taxed at 30 percent (30)37). France allows long-term capital gains and losses of the same fiscal year to be offset against each other. Any remaining net after-tax gain (after off-setting) is credited to a special reserve, where it is allowed to remain for an indefinite period of time. If capital gains in the special reserve are distributed as cash dividends, a complementary tax equal to the difference between the long-term capital gains tax and the corporate tax is assessed. If the amount is a loss (after off-setting), it may be carried forward for 10 years to offset future long-term capital gains (36).

The United States and Japan have investment tax credits. In the United States, the credit is equal to 10 percent of qualified investment in depreciable property up to 70 to 100 percent of the tax liability for the year the equipment was placed in service; the excess may be carried over. In Japan, the credit is equal to 10 percent of the purchase price up to *20* percent of total corporate tax liability in the year of purchase for certain industries; the excess may be carried over for 3 years.

CORPORATE TAXATION

The top-bracket corporate tax rate on retained earnings or distributed earnings in the United States for established companies is 46 percent. The corporate tax rate in Japan is 40 percent on retained earnings and 30 percent on distributed earnings. In the Federal Republic of Germany, the corporate tax rate is 56 percent on retained earnings and 36 percent on distributed earnings. In United Kingdom, the corporate tax rate on retained earnings is 52 percent. In France, the corporate tax rate is 50 percent (42).

For international comparisons, effective corporate tax rates should be used rather than the statutory rates just cited. The effective rates take into account different definitions of taxable income and treatments of depreciation. Available studies suggest that effective corporate tax treatment in the Federal RepubIic of Germany, France, and the United States is relatively equal, with Japan and the United Kingdom having lower effective corporate tax rates; however, these studies need to be updated.

In Switzerland, different cantons have different corporate tax rates: some allow taxes that are paid to other tax authorities as a deduction; others have different loss carry-forward provisions; still others will tax capital gains at a separate rate or not tax the gains at all. The effective corporate tax rates (including Federal defense taxes) in Switzerland range from 8.85 percent to 36.89 percent, depending on the size of profits and the particular canton (38). These tax rates are among the lowest in Europe, and Switzerland is favorable in its treatment of established companies. Switzerland does not have any special treatment for small businesses, only for companies that invest in the equity of other companies and derive most of their income from dividends.

Findings

As a factor determining competitiveness in the commercial development of biotechnology, financial resources to support entry into this new field are of critical importance in all countries, especially now when the technology is new and its applications are just being developed. Financial resources available to commercialize biotechnology are greatest in the United States and Japan and somewhat

25-561 0 - 84 - 20

less in the four other countries examined: the Federal Republic of Germany, United Kingdom, Switzerland, and France.

In the United States, a variety of funding sources are available to support the commercialization of biotechnology in both NBFs and established companies. Most major U.S. corporations have sizable internal sources of funds and are therefore less likely than NBFs to use external sources of funds to support R&D efforts in biotechnology. If external funds are needed, however, they are most likely to be obtained through debt financing.

Funding needs of NBFs depend on the market selected for entry. Funding needed to support entry into the contract research market is very low. Higher, but still quite low, are the funds needed to manufacture in vitro MAb diagnostic products; indeed, such product lines should be profitable within 2 to **3** years. Greater financial resources are required to enter the pharmaceutical market involving products for internal human use because of the expense of testing and clinical trials to obtain FDA approval. Nevertheless, about 55 percent of the NBFs in the United States plan to enter this market. * The amount of financial resources needed to enter the specialty chemicals market varies depending on the product. Most specialty chemicals do not require regulatory approval; however, FDA approval is required for specialty chemicals considered foods or food additives. Because research is near term for many of the products, 3 to 5 years, and most do not require approval, the financial costs of entering this market fall between those for the contract research and commodity chemicals markets. Very great financial resources are needed if an NBF wishes to enter the market for applications to plant agriculture requiring the manipulation of many genes, such as nitrogen fixation or photosynthesis, because a great deal of basic science remains to be done before commercial applications can be achieved, so a firm must plan on many years of research without financial return. Entry into the commodity chemicals market also requires major financial resources, because economies of scale are essential for economic production, and production plants for commodity chemicals cost millions of dollars. The commodity chemicals market is a risky one to select because it involves competition over a few cents difference in price, Additionally, the biotechnology that would be used needs substantial basic research.

The major sources of financing available to NBFs in the United States may be broadly categorized as:

- revenues from contract research and interest on cash previously obtained from public or private offerings,
- various sources of venture capital, and
- public stock offerings.

Research and product development agreements between NBFs and established companies are generally cost reimbursement contracts with additional incentives for reaching agreed upon milestones. Prepayments and advance payments may be obtained, and licensing agreements may bring royalties to the NBF from marketable products of the research. The funding that NBFs receive from research contracts is likely to diminish in the future as large corporations establish greater in-house capabilities in biotechnology. The funds available from corporate sponsors will increasingly be for truly innovative research, which historically has been done by small firms. As contract research funds decrease, however, many NBFs may find themselves in financial jeopardy.

Venture capital sources include venture capital from major corporations, R&D limited partnerships, venture capital funds, and SBICS. SBICS have provided relatively little venture capital to NBFs, although recently an increasing number of equity investments in new firms including NBFs have been made by SBIC bank affiliates. Many equity investments have also been made by major corporations in NBFs. Such investments appear to be motivated more by the corporations' desire to gain "a window on the technology" than by the hope of financial gain from their investments.

Some venture capital firms are set up by major corporations to invest corporate funds in new ventures. Because the firms are independent entities, the corporation is protected from loss. If suc-

● The commercial applications of biotechnology being pursued by NBFs are discussed in ***Chapter 4: Firms Commercializing Biotechnology***

cessful, the venture firm returns some profits to the parent corporation. Other venture firms have no connection to major corporations. Venture capital firms can provide seed money (used to write business plans for new firms), but most often, they fund startups, underwrite public offerings, and invest in R&D limited partnerships as limited partners. A few of these firms have invested a significant amount of their money in NBFs.

R&D limited partnerships are a very important source of funds for NBFs; next to public offerings, R&D limited partnerships have so far provided the most funds for NBFs. Although such partnerships have been available for some time, NBFs are responsible for popularizing their use. Such partnerships have enabled NBFs to attract the substantial funding needed to fund research and early product development and have also been formed for novel purposes, such as supporting the cost of clinical trials.

The number of public stock offerings in biotechnology in 1982 declined to about half the number in 1981, paralleling a similar decline in the number of public offerings in all U.S. industrial sectors. Furthermore, the amounts raised by NBFs in 1982 public offerings were less than NBFs had hoped for. The disappointing return on public offerings probably reflected increased public knowledge about biotechnology and more realistic appraisals of the time necessary before investments in biotechnology are likely to pay off. Thus far in 1983, there is a boom in the new issues market and a large number of NBFs are using the market as a means to finance expansion. Between March and July of 1983, 23 NBFs raised about $450 million (18). The stock market is also providing newly public NBFs with second- and third-round financing. Some of these firms, however, may encounter future financial constraints if they continue to rely on the stock market, because many investors are interested in relatively short-term returns.

In European countries and Japan, there is significantly less venture capital available than there is in the United States, and venture capital has therefore not been a major funding source for biotechnology R&D. Furthermore, because of a lack of venture capital in these countries, the number of NBFs in Europe and Japan is tiny compared to the number of NBFs in the United States. Some governments, such as those in France, Japan, and the United Kingdom, have attempted to stimulate the formation of venture capital, but the results have been disappointing. Outside the United States, direct government funding of industry is proportionately a far more important funding source for the commercial development of biotechnology than it is within the United States. In Japan, corporate funds supply most of the financing for biotechnology'.

The United States tends to use tax incentives more than direct government funding to encourage industrial development. In the United States, the tax measures aimed at capital formation and R&D are important to NBFs in their present stage of development, As scale-up proceeds, tax measures aimed at R&D capital assets will become more important. The United States tax code offers no special incentives, beyond those available for investment generally, for investment in depreciable structures or for equipment used for research and experimental design. Currently, France and the United Kingdom have accelerated write-offs for R&D capital assets, and West Germany has an investment grant allowing a com - pany to recover up to 20 percent of the cost of R&D capital expenditures. Japan also has extremely favorable depreciation allowances for capital assets used in R&,D for members of Government Research Associations such as the one formed for biotechnology].

Available studies suggest that Switzerland, followed by Japan and the United Kingdom, have the lowest effective corporate tax rates. The effective rates in the United States, the Federal Republic of Germany, and France are higher and about equal.

In most countries, proceeds from patents are treated as either capital gains income or ordinary income. In the United Kingdom, however, proceeds from patents are taxed as corporate income

(at a rate of 52 percent). Royahies are taxed as ordinary income, except in France under certain circumstances. From a tax viewpoint, the United Kingdom has the most adverse treatment of income derived from innovational activity, because proceeds from patents are taxed at corporation tax rates and the long-term capital gains tax rate in the United Kingdom is the highest of the competitor countries.

The United States has the most favorable tax treatment for raising capital for smaller firms. This is an important advantage in fostering the growth of startup and small expanding firms. The people contacted in NBFs agreed that this feature of the U.S. tax system aided the formation of their companies, especially compared to the tax treatment abroad. Recently, OECD published a study comparing the treatment of small businesses among its members and concluded that the European governments had few policies directly aimed at small businesses (33). The European governments are trying to develop policies to encourage entrepreneurs, but there are cultural as well as economic obstacles to be overcome.

Issues and policy options

ISSUE 1: How could Congress help new biotechnology firms obtain the financing necessary for production scale-up?

Many NBFs in the United States are currently sustaining large losses because of the very large investment in R&D relative to operating revenues required to develop a biotechnology product. Most NBFs at present have few or no products to generate revenues and will have difficulty financing production scale-up. Furthermore, as more and more NBFs carrying large losses approach production stages in the future, financing difficulties are expected to increase. If NBFs do not have the financing necessary for production scale-up, the commercialization of biotechnology in the United States may be hindered.

Although many NBFs are currently using public stock offerings and R&D limited partnerships to obtain funds for scale-up, it is not at all certain that these sources of financing will remain available to them, The public market is not generally considered a reliable source of funds for investments characterized by long time horizons and high risk; and R&D limited partnerships may not be a reliable source of funds given current legal uncertainties and uncertain IRS interpretations which affect the tax status of the partnership, If future returns on investments are lower than expected by current investors or if the time horizons for biotechnology scale-up are longer than expected, these sources of financing might become less available.

It might be argued that sufficient investment capital is available to commercialize biotechnology in the United States and that the Government need not intervene with specially targeted guaranteed loans or special tax provisions to further stimulate the U.S. biotechnology effort. However, the commercialization of biological technologies appears more costly both in time and investment than other high technologies. For this reason, Government support may be necessary to maintain the current competitive status of the United States. To help NBFs obtain the financing necessary for production scale-up, Congress could adopt one or more of the following options.

Option 1: Provide guaranteed loans for production scale-up.

A guaranteed loan program, much the same as the 1950 V-loan program that supplied working capital for U.S. semiconductor firms, * could be formulated for biotechnology. Under a V-loan program for biotechnology, the Federal agency guaranteeing a loan would be obliged to purchase a stated percentage of the loan if the borrower defaulted. The loans would be granted at less than

*The development of the semiconductor industry is discussed in *Appendix C: A Comparison of the U.S. Semiconductor Industry and Biotechnology*.

prevailing interest rates and would thus decrease the cost of capital for the individual firm. Because the guarantees would not be tied to a particular loan but to a particular level of debt, they would serve as a system of revolving credit, As periodic repayments reduce the outstanding debt, additional loans could be taken out as long as repayment kept the debt within the face amount of the authorization. The V-loan program of 1950 authorized a total of $2.9 billion over its life, which permitted loans totaling about $11.6 billion. It also returned a profit to the Federal Government of about $24.5 million, because the Federal guaranteeing agent was entitled to a portion of the interest paid on the loan.

Funds for biotechnology earmarked for scale-up projects could be placed in a "Biotechnology Development Bank" or allocated to an interested agency such as the National Institutes of Health, National Science Foundation, or the SBA. The funds could be authorized for a specific amount and aimed at a particular level of debt, thus allowing ***successful*** biotechnology firms to pay back the loans to the level of debt only. once the level of debt was paid back, the firms could obtain additional funds from the agency/Bank.

Option 2: Allow rapid depreciation for capital assets required for production scale-up.

The current depreciation schedule for plant and equipment assets in the United States is a set of statutorily provided depreciation periods: 15 years for most structures, 5 years for most equipment, and 3 years for R&D equipment. This schedule is faster than earlier schedules and provides a greater incentive than was provided before for the purchase of long-lived equipment such as bioreactors. A depreciation schedule that would allow an even more rapid recovery of capital costs incurred in production scale-up would help alleviate some of the financial constraints faced by NBFs in production scale-up. The increased write-offs could be made available to investors through equipment partnership agreements or leasing arrangements. Such agreements would allow NBFs to obtain additional money instead of relying on tax provisions alone.

The Defense Procurement Act of 1950, which allowed participating firms to write off their capital expenditures in a 6-month period, could be used as a model for new legislation that would similarly benefit firms using biotechnology. The new legislation could allow NBFs to write off 100 percent of their expenditures for pilot plant equipment.

Currently, the United Kingdom and France have tax provisions applicable to scientific R&D equipment, allowing up to 100-percent write-offs in the first year. Congress could allow similar write-offs or accelerated depreciation for equipment used in biotechnology pilot plants.

Option 3: Refund the R&D tax credit to NBFs not earning enough taxable income on which to apply the R&D tax credit.

The R&D tax credit legislation currently allows unused tax credits to be carried over to each of the 15 taxable years following the unused credit year. For NBFs experiencing cash flow problems while scaling-up production, a tax credit refundable in the year sustained would help alleviate these financial constraints. In addition, in present value terms, a refundable tax credit would be more valuable to NBFs in the year earned than a tax credit carried forward to the years in which enough taxable income would be earned to take advantage of the credit.

The major disadvantage of this option would be the loss of revenue to the U.S. Treasury in times of high deficits. In addition, political and equity-related objections might be raised concerning Government rebates to businesses.

ISSUE 2: **How could Congress encourage broader use of R&D limited partner ships in biotechnology?**

R&D limited partnerships have been an important source of financing for NBFs. As noted above, NBFs incur high R&D costs relative to their revenues and have few marketable products. NBFs have found R&D limited partnerships useful vehicles by which to attract the substantial funding needed to fund research, early product development, and in the case of some pharmaceutical products, clinical trials required by FDA. Such partnerships may allow more NBFs to enter markets such as that for pharmaceuticals, where extensive regulation makes the costs of entry high.

Given the very large amounts of capital which will be required to support the further commercial development of biotechnology and the variability of the stock market as a source of funds through public offerings, R&D limited partnerships are probably critical to the survival and growth of NBFs. To encourage broader use of R&D limited partnerships and increase their role in providing financing for NBFs, Congress might consider the following options.

Option 1A: Amend section 1235 of the IRS code so that it ***applies*** to plant variety protection ***certificates.***

The most favorable tax treatment of income for R&D limited partnerships is provided under section 1235 of the IRS Code. Section 1235 treatment applies to a transfer of property consisting of all substantial rights to a patent by any holder. Under section 1235, any royalties received as a result of transfer of a patent qualify as long-term capital gains rather than ordinary income. Because they are legally distinct from patents, plant variety protection certificates are currently excluded from section 1235 treatment. Their exclusion from section 1235 treatment may have limited the use of R&D limited partnerships for biotechnology research in plant agriculture—an area where some of the most important applications of biotechnology are likely to occur. Adopting this option would very likely encourage the formation of R&D limited partnerships for plant-related biotechnology.

Option IB: Amend section 1235 of the IRS code so that universities are ***included*** in ***the definition of holder.***

Under section 1235, a holder is defined as any individual whose efforts created the patentable property or any other individual who has acquired interest in the patentable property in exchange for money paid to the creator prior to the actual reduction to practice of the invention. A holder cannot be the employer of the creator. This definition of holder may discourage some university/industry R&D limited partnerships. The present definition makes it difficult for an R&D limited partnership to acquire rights to a patent directly from the inventor when a university has such rights through its employment agreement with its scientists. Amending section 1235 to include universities in the definition of holder, in addition to allowing universities to obtain additional money, would enable wider use of R&D limited partnerships.

Option 2: Allow R&D limited partnerships to qualify for tax credits under the Economic Recovery Act of 1981.

Under the Economic Recovery Act of 1981, tax credits are provided for any incremental R&D expenses incurred above a 3-year moving average. The language as it is currently written and statements in the legislative history, suggest that R&D limited partnerships do not qualify for these credits. If they did, the credits could be passed on to the limited partners, thus making R&D limited partnerships more attractive to investors.

On the other hand, it can be argued that R&D limited partnerships are already attractive to investors. The additional incentive to investors that would be provided by enabling limited partnerships to qualify for the R&D tax credits might be small. The loss to the U.S. Treasury must also be considered.

Chapter 12 references

1. Arthur Anderson & Co., "National Research and Development Study," unpublished study, Washington, D.C., January 1983.
2. Biogen, N.V., Biogen Prospectus, Curacao, Netherlands Antilles, 1982.
3. *Biotechnology*, "Predicted Bankruptcies Fail To Materialize," October 1983, p. 646.
4. *Biotechnology News*, "Genentech Makes Monoclonals via rDNA, Forms New RDLP," 3(10):7, May 15, 1983.

5. *Business Week*, "A Furor Over Business Tax Breaks," Mar. 8, 1982, p. 28.
6. *Business Week*, "Tokyo Tries To Encourage Equity Financing for Startups," Oct. 11, 1982, p. 54.
7. *Business Week*, "High Tech Tries an End Run Around Germany's Banks," July 18, 1983, p. 74.
8. Byers, B., Kleiner, Perkins, Cayfield & Byers, interview cited in L. W. Borgman & Co, "Financial Issues in Biotechnology," contract report prepared for the Office of Technology Assessment, U.S. Congress, March 1983.
9. Committee for Economic Development, Research and Policy Committee, *Stimulating Technological Progress* (New York: Committee for Economic Development, 1980).
10. *Corporate Financing Week*, "New Fund Narrows Focus," 8(6):6, Nov. 1, 1982.
11. E. F. Hutton & Co., Inc., Washington, D.C., personal communication, July 18, 1983.
12. E. F. Hutton & Co., Inc., Washington, D.C., personal communication, August 1983.
13. Eli Lilly & Co., Eli Lilly Report, South Bend, Ind., Feb. 9, 1982.
14. Erickson, T., Arthur D. Little, Inc., "Worldwide Pharmaceutical Industry Overview: The Context for Shifting R&D," at seminar on Research and Development in the Global Economy, Institute for Alternative Futures, Alexandria, Va., Apr. 11, 1983.
15. Farrell, K., "Going Public 1982," *Venture*, April 1982, p. 30.
16. Feldman, M., and O'Malley, E., *The Biotechnology Industry in California*, submitted to the California Commission on Industrial Innovation, Sacramento, August 1982.
17. Fishlock, D., "Biotechnology Fund Still Seeks British Investment," *Financial Times*, Jan. 11, 1983.
18. *Genetic Technology News*, "Public Invests Nearly Half Billion in Genetic Engineering," 3(8):5, August 1983.
19. Hardy, R., "Biotechnology: What, How, Where, and When," *Japan Techno-Economics Society Forum Technical Feature* 11, Oct. 30, 1981.
20. Harsanyi, Z., E. F. Hutton & Co., Inc., New York, personal communication, March 1983.
21. Howard & Co., Philadelphia, personal communication, 1983.
22. *Japan Economic Journal*, "Japan Associated Finance Forms U.S.-Type Venture Capital Funds," Mar. 23, 1982.
23. Jasanoff, S., "Public and Private Sector Activities in Biotechnology: Federal Republic of Germany," contract report prepared for the Office of Technology Assessment, U.S. Congress, January 1983.
24. Jasanoff, S., "Public and Private Sector Activities in Biotechnology: Switzerland," contract report prepared for the Office of Technology Assessment, U.S. Congress, January 1983.
25. Jungwirth, J., Hybritech, San Diego, Calif., personal communication, February 1983.
26. Jungwirth, J., Vice President, Finance, Hybritech, cited in L. W. Borgman & Co., "Financial Issues in Biotechnology," contract report prepared for the Office of Technology Assessment, U.S. Congress, March 1983.
27. L. W. Borgman & Co., "Financial Issues in Biotechnology," contract report prepared for the Office of Technology Assessment, U.S. Congress, March 1983.
28. Marsh, D., "Looking for Closer Relationship," *Financial Times*, Nov. 12, 1982.
29. Michaud, S., "The Dark Side of R&D Shelters," *Venture*, November 1982, p. 28.
30. National Science Foundation, *Corporation Income Tax Treatment of Investment and Innovation Activities in Six Countries*, Washington, D.C., 1981.
31. National Science Foundation, *An Early Assessment of Three R&D Tax Incentives Provided by the Economic Recovery Tax Act of 1981*, PRA report 83-7, Washington, D.C, April 1983.
32. *Nihon Keizai Shimbun* (Japan Economic Journal), "Dainiji bencha boomu torai (The Second Venture Capital Boom is Coming)," Sept. 9, 1982.
33. Organisation for Economic Co-Operation and Development, *Innovation in Small and Medium Firms*, Paris, 1982.
34. Pratt, S. (ed.), *Guide to Venture Capital Sources* (Wellesley Hills, Mass.: Capital Publishing Corp., 1981).
35. Price Waterhouse & Co., *Price Waterhouse Information Guide: Doing Business in Germany*, September 1978.
36. Price Waterhouse & Co., *Price Waterhouse Information Guide: Doing Business in France*, 1979.
37. Price Waterhouse & Co., *Price Waterhouse Information Guide: Doing Business in the United Kingdom*, 1980.
38. Price Waterhouse & Co., *Price Waterhouse Information Guide: Doing Business in Switzerland*, 1982.
39. Saxonhouse, G., "Biotechnology in Japan," contract report prepared for the Office of Technology Assessment, U.S. Congress, June 1983.
40. Sladovich, H., E. F. Hutton, Washington, D.C., personal communication, August 1983.
41. Strogen, D., Princeton Montrose Partners, interview cited in L. W. Borgman & Co., "Financial Issues in Biotechnology," contract report prepared for the Office of Technology Assessment, U.S. Congress, March 1983.

42. U.S. Congress, Congressional Research Service, *Tax Rates in Major Industrial Countries: A Brief Comparison,* No. 80-224E, Washington, D.C., December 1980.
43. Vaquin, M., "Biotechnology in Great Britain," contract report prepared for the Office of Technology Assessment, U.S. Congress, February 1983.
44. Vaquin, M., "Biotechnology in France," contract report prepared for the Office of Technology Assessment, U.S. Congress, February 1983.
45. *Venture Capital Journal,* "Evolution of an Industry: Venture Capital Redefined for the 1980's," January 1980.
46. *Venture Capital Journal,* "Venture Capital Disbursements 1981: A Statistical Overview," 22(6):7, June 1982.
47. *Venture Capital Journal,* "Special Report—The Growth of An Industry, Venture Capital 1977-1982," 22(10):7, October 1982.
48. *Venture Capital Journal,* "Capital Transfusion 1982," 23(1):6, January 1983.
49. Virolleaud, P., "Research Finally a Tax Break," *L'usine Nouvelle,* Oct. 21, 1982, p. 75. Translated by the Foreign Broadcast Information Service in *West Europe Report, Science and Technology* (Joint Publications Research Service, Arlington, Va.).
50. Werner, J., Director, Program Policy and Evaluation Staff, U.S. Small Business Administration, Washington, D.C., personal communication, January 1983.
51 Yamamura, K., University of Washington, personal communication, July 1982.