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Volume Author/Editor: Lance E. Davis, Robert E. Gallman, and Karin Gleiter

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Chapter Author: Lance E. Davis, Robert E. Gallman, Karin Gleiter

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11 Profits

The concept of profits is among the most important in economics; it is also among the most difficult to deal with, both theoretically and empirically. The idea seems simple: "Economic *profit* is . . . the difference between the revenue a firm receives and the costs that it incurs."[1] But how should revenue and costs be defined and measured? For example, the returns to owner-managers are presumably part profits and part factor payments. Factor payments can be separated out from true profits, if there is evidence of the labor opportunity costs of owner-managers. Entirely apposite evidence of this type is, however, rarely available. Because estimates of management costs are thus subject to error, so are estimates of profits.

At another level of analysis, profits may be understood either in terms of their sources or in terms of the functions they are supposed to perform. For example, the profits of monopolists, oligopolists, and firms in imperfect competition come from control over the market. For present purposes, models of market control are not very helpful. Individual New Bedford whaling firms had no significant ability to affect the prices of whale products, nor was it possible for them to differentiate their outputs effectively from the outputs of other firms. There were too many firms in the market, dealing with products that were quite homogeneous.

The competitive model is more useful, although it, too, is less than perfectly designed for the analysis of the whaling industry. In competition, profits, if they are expected to continue, can motivate entrepreneurs to enter an industry, and losses can convince firms in the industry to try their luck elsewhere. Thus profits and losses signal future changes in the size of the industry: "[I]n long-run competitive equilibrium of the industry the firm has zero actual profits. . . . The zero actual profits condition is often qualified by adding that this does not

1. Varian 1978, 1. This is the leading graduate textbook in microeconomic theory.

rule out 'normal' profits.This not only leaves normal profits indeterminate in size but could easily lead to the condition of normal profits being a tautology" (Desai 1987, 1014). There are also questions about what service "normal profits" reward and, if none, why they are not competed away.

Nineteenth-century whaling (like all other industries) did not conform precisely to the assumptions of the competitive model. In the standard model there is no risk; this is contrary to the situation faced by whaling firms. Whalemen could insure out from under some risks, as can any firm. The costs of insurable risks—whether a firm bears them itself or buys insurance—should be excluded from profits, and the measures of profits treated in this chapter are net of such costs. Other forms of risk cannot be insured against, and their costs are normally treated as part of profits. Two types of uninsurable risks may be distinguished: those of an unmeasurable form—given the name *uncertainty* by Frank Knight ([1921] 1971)—and those that are measurable but cannot be insured against for reasons of moral hazard.[2] Assuming whaling investors were risk-averse, equilibrium profit rates should have settled at a positive level—sufficient to encourage the bearing of uninsurable risks. One might think of these returns as normal. The fact that *normal profits* are positive in the real world of uninsurable risks—and that their level is unpredictable in a world of uncertainty—makes the empirical identification of equilibrium difficult, to say the least.

There is a second respect in which the historical whaling industry deviated from the standard neoclassical competitive industry. The neoclassical model assumes that all participants in the market have the same information. In fact, there were informational asymmetries in whaling. Agents tried to gain advantages over their competitors by restricting access to knowledge of the routes and timing of whale migrations (see chapter 10). They used voyage journals and other sources to construct notebooks of such data and passed them on to the captains who sailed for them. Each captain was, of course, sworn to secrecy. There is some question as to how long the captain felt bound by his oath, given the relatively transitory nature of the captain-agent relationship. A captain who had sailed for the Howlands and then transferred his services to the Wings was unlikely to regard his promise of secrecy to the Howlands very seriously, particularly since such loyalty could prove personally costly. None-

2. To Knight, and for the purposes of this chapter, a *risky* event has an unknown outcome, but the probability distribution of the possible outcomes is known. An *uncertain* event has an unknown outcome, and the probability distribution of the potential outcomes is unknown. In principle, since it would be possible to hold a portfolio of risky events and thus guarantee an "average" return, insurance is possible. With no information about the distribution of possible outcomes, no portfolio of uncertain events can guarantee an "average" return. Moral hazards, moreover, may make insurance of some risks either impossible or prohibitively expensive. It is impossible, for example, to insure out from under business risk, since the risks are not independent of the actions of the insuree. It is difficult to understand how the owners of the professional baseball teams in the major leagues were able to buy "antistrike" insurance in 1981, since the very existence of the insurance increased their willingness to accept a strike. It should be noted that the strike was settled as soon as the insurance expired, and no one has since been willing to provide such insurance.

theless, it may well be that good information, carefully analyzed, made some agents more successful, in the long run, than others. More generally, some agents were simply better at the job than others. It is unlikely that all of the rents due such agents were taken out in the form of agents' fees; fee rates seem to have been standardized. These rents may have been partly incorporated in profits.

All these notions are essentially static. Profits can also be viewed in a dynamic context—as payments to entrepreneurs to compensate them for successfully undertaking innovative activities. In the words of Joseph Schumpeter ([1934] 1961, 128–29), "Entrepreneurial profit is a surplus over costs. From the standpoint of the entrepreneur, it is the difference between receipts and outlay in a business, as we have already been told by a long line of economists." In a static world in equilibrium, receipts and outlays are equal; in a dynamic economy characterized by technical and institutional innovation, "since the new combinations which are carried out if there is 'development' are necessarily more advantageous than the old, total receipts must in this case be greater than total costs." To Schumpeter, these positive net receipts "will fall to those individuals whose achievement is to introduce the looms, whether they produce and use them, or whether they only produce or only use them. . . . They have 'carried out new combinations.' They are entrepreneurs. And their profit, the surplus, to which no liability corresponds, is an entrepreneurial profit" (132).

For any single innovation, Schumpeterian profits are relatively short-lived. They will last only until the herdlike movement of copycat innovators competes them away—a process described by the standard neoclassical model. Of course, as Schumpeter quickly notes, given asymmetric information, it may take the herd a long time to catch up. Furthermore, in a dynamic world with changing technical and institutional menus, an innovating entrepreneur may be able continually to stay one step ahead of the competition.

The profits earned in nineteenth-century whaling were composed of all four types of profit described above: payments for bearing uninsurable risks, rents on knowledge and managerial skill, disequilibrium profits (for example, profits arising out of a sudden increase in demand), and returns to innovation. Unfortunately, there is no entirely reliable way to separate the four. (The last two are particularly difficult to distinguish.) Nonetheless, the theoretical constructs can help in the analysis of change in the industry. If disequilibrium profits were important, it should be possible to identify that fact from the relationships between profit levels and the expansion or contraction of the industry. If rents on knowledge and skill were large, and if some firms were particularly innovative, then long-term profit rates should have varied among firms, and the innovative firms and those with special knowledge and skills should be identifiable.

The chapter proceeds as follows. First, we canvass the opinions of contemporaries and historians of the industry with respect to the general level of profits. Then we turn to the new estimates of profit rates assembled for this

book. We discuss the methods of estimation, the average level of the profit rate, changes in the profit rate across time, factors influencing the profit rate, and the profit experiences of the leading whaling firms. Finally, we compare the average profit rate of the whaling industry to profit rates of other leading industries of the day.

The preceding paragraphs suggest that the concept of profit is difficult to operationalize. Attempts to assess profits have left both contemporaries and generations of historians divided and puzzled. Given the usual tone of his work, it is not surprising that Samuel Eliot Morison is the most glowing in his reports of the earnings of businessmen whose business was whaling. In *The Maritime History of Massachusetts* (1961, 319) he writes: "It was a golden age for owners. The ship *Lagoda*, belonging to Jonathan Bourne and others, netted them an average of ninety-eight per cent profit for each of the six voyages she made between 1841 and 1860. Several simple Quaker families of 1815 had become millionaires by 1840." He adds in a footnote, "On her next voyages, during the Civil War, the *Lagoda* netted her owners 219 and 363 per cent profit." Morison's estimates—as well as the rest of the estimates discussed in this section—almost surely fail to take into account some costs (such as the cost of capital and the cost of management), and therefore overstate profits and profit rates. Nonetheless, the voyages he describes were highly profitable ventures.

Lewis Holmes (1857, 145) concluded that whaling was about as tempting to the investor as any other alternative. Alexander Starbuck (1878, 145), summarizing his research on the industry through the mid-1870s, reported:

> While some vessels on their voyages have made but poor returns, even bringing, in numerous cases, positive and at times damaging loss to their owners, others have done extraordinarily well, and brought in fortunes to those investing in them. The ups and downs of the business made it alternately profitable and, if not positively losing, at least hazardous. This was the fact when no unusual accident occurred, but in case of a disaster it changed the beam of the balance from the speculative to the unmistakably negative side of the account.

Starbuck's account does not differ significantly from that of J. T. Brown (1887, 293), who, writing for a census volume a decade later, reported, "The profits of the whalemen have for many years been uncertain."

Morison's figures for the *Lagoda* were drawn from the reports of Benjamin Baker, who, as a long-time employee of the vessel's owners, had access to their confidential accounts. The accounts indicate that profits were substantial, but perhaps not as substantial as Morison suggests. Baker's figures for the nine voyages between 9 October 1841 and 5 June 1873 are 30, 121, 67, 177, 100, 97, 364, 219, and 115 percent; but those are voyage, not annual, profit rates.[3] Adjusting for time at sea produces a substantially different, although still quite rosy, picture: annual rates of 15, 47, 24, 63, 39, 25, 100, 57, and 24 percent, or

3. The full series is reported in Hohman 1928, 282.

a time-weighted average of 45 percent. If the *Lagoda* was used only for whaling during the period covered by the nine voyages, correcting for time in port reduces the average profit rate to 41 percent for the period between 9 October 1841 and 5 June 1873. Moreover, the next three voyages yielded a loss of $14,460, a gain of only $6,414, and a loss of $10,254.

In 1859 *DeBow's Review* (26 May, 590) reported that the annual profits of the 661 whaling vessels that sailed from the United States averaged 46 percent.[4] That calculation is a peculiar one. *DeBow's* profit rate is the ratio of the value of oil returned to the sum of estimates of initial investment, interest on initial investment, depreciation, insurance, supplies purchased while at sea, and wages. If the figures are reorganized to conform more closely to a definition of accounting profits, the average figure is a still substantial 25.6 percent.[5] Similarly, Starbuck (1878, 148) reports that 154 vessels, valued with outfits at $4,650,000, hunted in the Arctic in 1849 and that "the value of that season's catchings was $3,419,622." If those figures are adjusted to reflect costs, in line with the *DeBow's* data for a decade later, the implied annual profit rate was 26.2 percent.[6]

There are also numerous reports of particularly successful voyages. Starbuck (1878, 148), for example, notes that in 1853 the Fairhaven bark *Favorite* returned from a three-year voyage with a catch worth $116,000; the ship *Sheffield*, out four years, returned with a catch worth $124,000; and the ship *Montreal* brought back a catch worth $136,023.19 after a voyage of thirty-two months and fifteen days. About the *Montreal*'s catch Dias writes, "[O]ne of the greatest on record" ("Catalogue of New Bedford Whaling Ships," 155).

If these were the only reports of contemporaries and historians, one might conclude with Morison that whaling owners and agents were well rewarded for their effort, but not all paint such a rosy picture. In 1846, for example, Charles Enderby, a member of Britain's most famous whaling family and head of Britain's largest whaling firm, estimated that the average annual rate of return for both the American and the British fleets amounted to about 6.5 percent in right whaling and 1.3 percent in sperm whaling.[7]

In the same vein Starbuck (1878, 149) estimates that, of the eighty-one

4. It is not clear to what year these figures refer, but they are annual, not voyage, rates. Since in no year does Starbuck report more than 254 vessels returning to the United States (that year was 1854), the figures most likely refer to the entire number of vessels at sea.

5. The new measure is the ratio of revenues less costs to initial investment. That is, value of the annual amount of oil taken ($12,013,805), less the sum of interest on the initial investment ($991,500), depreciation ($1,600,000), insurance ($413,125), fresh supplies ($793,000), and wages ($4,013,601), divided by the initial investment ($16,525,000).

6. The price level in 1849 was 0.863 of the level in 1859. The costs of seamen's advances and fresh supplies have been adjusted to reflect that difference. Total revenue ($3,419,622), less the sum of interest ($284,702), depreciation ($474,503), insurance ($118,626), fresh supplies ($159,482), and wages ($1,139,863), was divided by the initial investment (the sum of vessels and outfits, valued at $4,650,000, and seamen's advances of $95,025) in order to calculate the profit rate.

7. Charles Enderby, *Proposal for Re-establishing the British Southern Whale Fishery*, cited in Hohman 1926, 667. These are pure profit rates, exclusive of interest. Hohman's calculations are not quite correct; the rate for the right-whale fishery, as judged by Enderby, is 6.3 percent.

whalers arriving in 1837, "53 made paying voyages, 8 made saving ones, 11 lost money, and 9 involved their owners in severe losses . . . . Of the 68 whalers expected to arrive in New Bedford and Fairhaven in 1858, 44 were calculated as making losing voyages, and the same proportion would apply to other ports. The estimated loss to owners during this year was at least $1,000,000."

Reporting on business during 1869, the *WSL* (1 February 1870) noted, "Of the 102 whalers that have arrived during the year, only about one-quarter may be said to have made profitable returns, even those, at present prices, would barely have saved their owners from a loss." Three years later (4 February 1873), the paper reported, "The continued purpose to sell whalers after so great a depletion in little more than a year, shows the judgment of those who have long and successfully been engaged in the business, viz: that it has become too hazardous, and its results too uncertain to continue it, when capital is promised a safer employment, and surer rewards in enterprises on the land, and in our own city, where the products of two large Cotton Mills equal very nearly the aggregate value of the imports of the fishery yearly." Nor did business improve in 1873. The paper (27 January 1874) lamented:

> A proposition for the sale of a whaler is more tempting than a proposal to fit one. Of the 19 whalers in the port of New Bedford, January 1st, 1873, 4 were sold, 5 fitted for whaling, and 10 still remain in port; of the 7 at New London, January 1st, 1873, 1 has been sold and broken up, and the remaining 6 are still for sale. Of the 11 whalers now in this port that arrived in 1873, 6 are for sale; and of the 21 whalers now wintering here, not over 7 are likely to be fitted. Of 40 whalers to arrive in 1874, probably about 30 will be sent to sea again.

Counterbalancing the occasional reports of large catches were the reports of economically disastrous ones. Ignoring vessels that returned clean or not at all, there were still those that can be called catastrophic, at least from the point of view of seamen, agents, and owners.

> The brig Emeline, of New Bedford, Captain Wood, sailed from port on the 11th of July, 1841. The captain was killed by a whale in July, 1842, and in September, 1843, the brig returned, bringing home only 10 barrels of oil as the result of a 26 months' cruise. The Benjamin Rush of Warren sailed in October, 1852, for the Pacific Ocean. On the coast of Japan the captain and his boat's crew were lost by a whale. This, combined with the extremely poor success that had attended the vessel, had so discouraging an effect upon the crew that it was considered useless to prolong the voyage, and she returned to port under charge of the cooper in 1853, having obtained but 50 barrels of sperm-oil and 40 of whale. On her voyage she had circumnavigated the globe. (Starbuck 1878, 149)

The best summary of the literature can be found in Elmo Hohman's classic study of the American whaleman (1928, 284). After noting the disastrous seasons of 1837 and 1858, the Arctic destructions of 1871 and 1876, the assaults

of the Confederate cruisers *Shenandoah* and *Alabama*, and "the lists of vessels which were wrecked or reported missing with all hands," he concludes that "[t]he financial results of American whaling . . . covered the whole range between ruinous losses and magnificent profits. But, though the available figures do not warrant precise and conclusive assertion, it is evident that the cases at each extreme offset each other so effectually that the long-run, normal rate of profit for the industry as a whole was an essentially modest one."

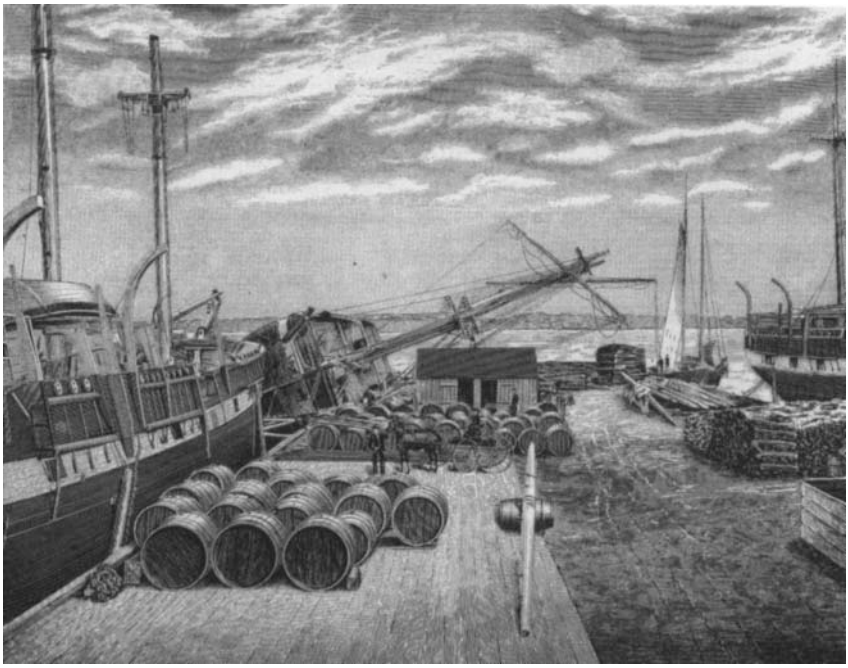
Hohman's judgment was made after examining reports of many voyages, but he never systematically computed the average profit rate. The data collected for this book make such a computation possible. The data also permit good estimates to be made of annual profit rates, profit rates earned hunting each of the main grounds, the earnings of individual agents, and, of course, the earnings realized from individual voyages. With these data the propositions appearing in the literature—such as Hohman's assertions concerning long-run profit—can be tested. The pattern of changes in profit rates emerging as time passed can also be recovered, and the degrees of success and failure of the leading whaling firms can be established. Some notion of the scale of average returns from bearing uninsurable risk, from the exploitation of special information, and from innovative activities can be obtained. Finally, the data permit the comparison of whaling profit rates with those of other activities of the day.

Our calculation of profits for a voyage began with an estimate of the real value of its catch (see chapter 8). The real value consists of the outputs of sperm oil, whale oil, and whalebone, multiplied by the average prices of these products in the year the vessel returned to New Bedford, divided by a general price index.[8] The following costs (expressed in real terms, i.e., divided by the same general price index) were subtracted from these returns: (1) the cost of subsistence of the crew, (2) the share of output earned by the crew, (3) the value of vessel outfits (sails, rigging, whalecraft, etc.) consumed during the voyage, (4) depreciation on the hull and masts, (5) imputed interest on investments in the vessel, in the outfits, in advances to seamen, and in articles of subsistence, (6) the agent's fees, and (7) the cost of insurable risk—the risk of the loss of the vessel. No adjustments were made for the normal business risks associated with the search for whales and with the changing state of the products markets—uninsurable risks.

The profits computed in the manner described above would measure the return to the bearing of Knightian risk, the rents to special knowledge and managerial skills, disequilibrium profits, and the rewards of Schumpeterian innovative behavior, were the lists of returns and costs complete. They are not quite complete. For the fleet as a whole, the procedure ignores incidental income (money earned through the sale of trade goods, for example), and it ig-

8. All calculations were made in real values, although, since one price index series was used to deflate all series, the ultimate results—profit rates—would have been the same, had all calculations been made in nominal values. The deflator employed is the Warren and Pearson "All Commodities" wholesale price index (U.S. Department of Commerce 1975, series E-52).


Point Barrow
Barrow
Point Belcher
Wainwright
ALASKA



"Whale-ships at New Bedford wharves; ship hove down for repairs; oil-casks," in *The Fisheries and Fishery Industries of the United States,* compiled by George Brown Goode and published by the U.S. Commission of Fish and Fisheries in 1887.

Opposite: Abandoning the barks *George, Gay Head,* and *Concordia* in the ice off Point Belcher, 14 September 1871—a wood engraving from a sketch by Captain Kelley of the *Gayhead.* In the early fall of 1871, virtually the entire Western Arctic whaling fleet—thirty-two vessels, of which twenty-one were from New Bedford—were trapped in the ice. On 14 September the decision was made to abandon them, and the 1,219 officers and men began their trek south. The vessels had aboard 13,665 barrels of whale oil, 965 barrels of sperm oil, and 100,000 pounds of baleen. Vessels and cargoes were worth together about $1.5 million, all of it lost. George and Matthew Howland lost three vessels, about one-third of their fleet, none insured (Allen 1973, 248–49).

Engraving reproduced courtesy of the Old Dartmouth Historical Society–New Bedford Whaling Museum. Map by Philip Page.

nores some minor costs (offloading the vessel, watchmen's fees, etc.). These are minor omissions, and should not markedly affect either the level of or the trend in the average rate. In some instances, however, the estimate for an individual voyage may be substantially wrong. Some vessels earned freight income by carrying home the output of more successful vessels. The estimates in this chapter take no account of these transactions, tending therefore to understate the income of unsuccessful voyages and to overstate the income of successful voyages.[9]

A lack of voyage-specific information about some other elements further diminishes the reliability of the individual voyage estimates, but not necessarily the average industry figures. (1) The prices of outputs are averages for the year in which the vessel returned to New Bedford, not the prices at which outputs were actually sold. (See appendix 9A; the problem may not be serious.) (2) The estimates rest on the assumptions that the real cost of subsistence per man per month was the same from voyage to voyage and vessel to vessel, that the real outfitting costs per ton per month at sea were unchanging, and that agent fee rates were constant across agents and years. These assumptions also figure in the estimates of imputed interest on investment. (3) For most of the voyages beginning in the years 1840–58 and 1866 (well over one-third of those analyzed in this chapter), the data contain ex ante lays (see chapter 5). These data were used to establish the level and movement over time of the aggregate lay shares, and these values were interpolated and extrapolated to all the years in the data set. We assumed that lay shares were the same for all vessels leaving in the same year.[10] It seems improbable that these decisions cause major errors. A separate data set for the years 1840–58 and 1866, incorporating true lays, was assembled to test the basic data set. The results are encouraging.[11]

Depreciation posed special problems. The best way to begin the treatment

9. Freight costs and freight earnings cancel out in the aggregate, except insofar as merchantmen or whalers from ports other than New Bedford were involved. They were involved, but most of the freight transactions probably took place within the New Bedford whaling fleet.

10. Lays differed substantially from ground to ground, but lay shares did not. Specifically, lays were shorter in the Atlantic, but crews were also smaller. As a result, lay shares differed little. See chapter 5.

11. The two sets of profit-rate estimates (excluding capital gains) were computed across the same sets of voyages.

	Investment in Vessel Measured in	
	Net Reproduction Cost	Gross Reproduction Cost
Estimated lays	14.82%	7.03%
True lays	14.82	7.04

As a second test we computed the real value of output per ton-month minus the real value of lays, averaging across the experience of individual agents, and following the two techniques. The rank correlation between the two sets of estimates was .9935.

The "true" lays were negotiated before the voyage took place. Since the crew list usually changed during the voyage, the aggregate ex ante lay surely differed from the aggregate ex post lay on most voyages. The ex post figures are the ones required for profit calculations, of course, but few such records are available. The ex ante data represent the best estimates of ex post results.

of these problems is to consider the investment value of a vessel about to set out on a whaling voyage. The investment in such a vessel should be taken to be its opportunity cost (that is, its market price). If the vessel was newly built when it sailed, then its value could be inferred from prices in the new-vessel market. Specifically, for present purposes the vessel could be valued in terms of the prices in table 6.10. (In fact, the figures in the third column, extrapolated to the earlier years on the data in the first column, were used.) But suppose the vessel was not new? There are some data on old-vessel prices, but not enough to meet our requirements.

A second approach would be to approximate the market price of an old vessel by the depreciated new price. This point needs emphasis. *Depreciated new price* does not mean depreciated original cost or book value—figures unlikely to approximate the true market value of the vessel. Rather, the relevant concept is net (depreciated) reproduction cost, a concept that closely approaches market value. That is, we decided to value old vessels embarking on whaling voyages in the going prices of new vessels, depreciated to take into account the effects of age on value.

The abundant data for the New Bedford whaling fleet made computing the life expectancy of whaling vessels—and thus what would appear to be appropriate depreciation rates—an easy task. (Straight-line depreciation was employed.) The figures used to establish life expectancy refer only to vessels that were withdrawn from service by condemnation or because their owners thought they were no longer fit for service. Vessels that sank, for example, did not figure in the calculation of life expectancy. (The costs associated with lost vessels were taken into account in the estimates of insurance costs.)

The estimates of net reproduction cost may, however, understate the true average market value of a whaler when it sailed, because whalers were completely refitted at the beginning of each voyage. Although refitting activities concentrated on sails and rigging, rather than hull and masts—the relevant entities in this context—masts were sometimes replaced, and hulls were thoroughly worked over and frequently recoppered. That is, investment expenditures were made to offset some of the effects of age. Consequently, depreciated reproduction costs probably understate the average values of whalers.[12]

No satisfactory way to handle this problem was found. Therefore two investment variants were calculated: the first measures the value of the hull and masts at net reproduction cost (depreciated new price value), the second, at gross reproduction cost. That is, the second variant values the hull and masts at new prices, without any allowance for depreciation, assuming that old vessels were

12. Bear in mind that the proper investment value for the vessel is opportunity cost. Leaving the conceptual issue aside and considering only practical matters, ownership groups were not long-lived (see chapter 10). Consequently, new money investments in old whaling vessels were common.

The depreciated new price figures tend to overstate profit rates because they understate some elements of cost (e.g., imputed interest) and because they also understate the denominator of the profit rate. Under the right circumstances they can also lead to exaggerated rates of loss, since, again, the denominator of the loss ratio is understated.

so thoroughly prepared for voyages that they were equivalent to new vessels when they set out. Clearly, that is an exaggeration. The assumption leads to *overstatements* of investment values and thus to *understatements* of the rate of profit and, under the right circumstances, the rate of loss. The second variant, however, may be no farther from the truth than the first. The true values are surely bounded by the two variants. Similarly, in any given instance the true profit rate—or true loss rate—for a voyage is likely to lie between limits set by these two variants. With respect to aggregations of voyages, the first variant will produce the larger profit rates or, if there are losses, the larger loss rates.

Depreciation *during the voyage* was calculated by applying to the investment values of vessels the rates computed from the life-expectancy table.

New vessel prices also changed as time passed. Quite apart from depreciation, owners might incur capital losses due to a decline in vessel prices during the course of a voyage. If they were lucky and prices went the other way, they would obtain capital gains. Capital gains and losses certainly affected the success or failure of whaling firms, but they arose out of the operation of the market for vessels, rather than out of the whaling activities of the firm.[13] We therefore computed two sets of profits, one taking account of capital gains or losses, the other ignoring them. Most of the analysis here is based on the series exclusive of capital gains and losses, that is, the series relating expressly to whaling operations.

There are two ways to approach insurable risks: via the scanty information on insurance rates, and via the information on vessel losses in the New Bedford data set. The latter is clearly the better approach. Two sets of risks were estimated: the risk of destruction by a Confederate cruiser—a substantial risk in the early 1860s—and all others.

Finally, there is the question of the representativeness of the sample from which the profits calculations were made. The issues are similar to those regarding productivity discussed in chapter 8 (see table 8.1 and surrounding text); they need not be treated at great length here. Profit calculations were made for 2,757 voyages returning to New Bedford in 1817 through 1892. Another 640-odd voyages, for which there is considerable information but not enough to estimate profits, also ended in these years. The sample, then, contains over 80 percent of the observations in the universe (2,757/3,398—see table 11.1).[14]

13. Remember that the market for vessels was affected by circumstances in the merchant marine, as well as by the situation in whaling.

14. The term *universe* has the meaning implied by the previous sentence. That is, it refers to voyages returning in the years 1817 through 1892 for which there is information on at least one of the variables listed in table 11.1.

Table 11.1 is modeled after table 8.1. The data in the two tables differ in a number of respects, however. Chapter 8 is built around a regression analysis involving some lagged data. The relevant series begins in 1816, and the productivity calculations used in the regression therefore had to begin several years later. We chose to begin in 1821. There was no similar constraint for the beginning of the profits calculations. The only requirement was that the calculations not include data from the period of the War of 1812. Consequently, the profits series begins earlier than the productivity series.

Table 11.1 **Characteristics of the Voyages in the Profits Sample and of the Voyages Composing the Universe of New Bedford Whaling Voyages, 1817–92**

A. Outputs and Inputs

	Sample (N = 2,757)	Universe	N	Sample/Universe
Average output of				
Sperm oil (barrels)	802.9	758.9	3,398	1.058
Whale oil (barrels)	1,070.9	989.0	3,398	1.083
Baleen (pounds)	9,333.5	8,336.0	3,398	1.120
Average inputs				
Vessel size (tons)	323.3	306.4	3,467	1.055
Interval at sea (months)	33.8	31.5	3,470	1.073
Average value of catch ($)	52,478.4	47,738.2	3,398	1.099
Average value of catch per ton-month ($)	4.802	4.946	—[a]	0.971

B. Distribution of Voyages among Hunting Grounds (%)[b]

	Universe	Sample
Atlantic	32.1	25.4
Indian	12.9	14.7
Pacific	48.3	52.2
Western Arctic	6.7	7.7
Total	100.0	100.0

Sources: Voyages and Profits data sets.

Note: The years covered by the table are those in which voyages ended.

[a]The average value of the catch per ton per month was computed from the average value of the catch, the average vessel tonnage, and the average interval at sea, which rely on universes of differing sizes.

[b]Only voyages to one of these four grounds are reported (Hudson Bay and Davis Strait are included with the Atlantic).

The sample is large. Is it also representative? In certain important respects it is. For example, the average tonnages of the vessels in the sample and in the

Second, the profits calculations require data on the prices of vessels. These data run out in 1887 (see table 6.10). Consequently, we could not compute profits for those few voyages that began after that date. There was no similar constraint with respect to productivity. The productivity series therefore ends later than the profits series.

Third, the dates in table 8.1 (in fact, throughout chapter 8) refer to sailing dates, while the dates in table 11.1 (in fact, throughout chapter 11) refer to arrival dates; that is, table 8.1 records voyages that *began* in the years 1821 through 1897, while table 11.1 records voyages that *ended* in the years 1817 through 1892. This means that the temporal overlap of the series used to analyze productivity and profits is more limited than the titles of the two tables suggest. If the title of table 11.1 were changed so as to describe the sailing dates of the voyages treated in the table, it would refer to 1815 through 1887. The series described in table 11.1 thus begins six years earlier than the series described in table 8.1, and ends nine years earlier. The timing differences are unimportant, however, because there were relatively few whaling voyages from New Bedford beginning before 1821 or after 1887 (see table 2.5). Consequently, the analyses in chapters 8 and 11 treat essentially the same data.

universe are within 6 percent of each other (see table 11.1). The sample voyages resulted in relatively large catches—6 to 12 percent larger than for the universe—but they were also about 7 percent longer, on average. Consequently, the value of output per ton-month at sea is roughly the same for sample and universe: the sample recorded an average value 2.9 percent below that for the universe. The distribution of voyages among the four hunting grounds is also reasonably similar, although the sample underrepresents the Atlantic ground by quite a bit and overrepresents the three other grounds by small amounts.

These observations do not demonstrate beyond cavil that the sample is representative of the universe, but they do *suggest* that findings drawn from the sample can be generalized. Even if the results are taken as only descriptive, they are descriptive of a very substantial fraction of the total number of New Bedford voyages in the period under discussion.

The profit-rate estimates have many weaknesses. Nonetheless, they seem adequate to get at the most interesting questions concerning profits. Did rates fluctuate around a stable level, or did the level change over time? How did whaling's profit rates compare with rates in other industries? Is there evidence that there were important returns to information or to innovation?

The profit rate did fluctuate from year to year, as a glance at table 11.2 and figure 11.1 shows.[15] The movements are frequently very wide, but they are fairly brief: a string of increases or decreases never runs more than five years. There is the suggestion that the industry adjusted to profit rates, but that it repeatedly overshot the adjustment required to achieve equilibrium. Given the typical duration of a whaling voyage, the length of the adjustment period seems reasonable.

Of the two profit-rate series, variant B shows substantially lower values than variant A. Remember that the estimates of investments in vessels underlying these two sets of calculations differ. Vessels are valued at net reproduction cost in the computations for the variant A profit-rate estimates, and at gross reproduction cost for the variant B estimates. Naturally, then, investments—the denominators of the profit-rate figures—are smaller in the variant A than in the variant B series. Ceteris paribus, one could expect the variant A rates to be larger than variant B.

In fact, ceteris are not paribus. The differences in the investment figures for the two series affect not only the denominators of the profit-rate calculations, but also the numerators (i.e., profits). The profit calculations are affected because several of the cost estimates—insurance, depreciation, and implicit interest—depend upon the value of the vessel. Since the variant B series involves larger investments in vessels than the variant A series, the three elements of cost are larger for any voyage. That is, the profit ratios are computed from larger profit estimates and smaller investment figures in the case of variant A

15. The rates for each year refer to the profits earned on voyages ending in that year. The activities that yielded the profits often covered many years.

Table 11.2 **Mean Profit Rates of New Bedford Whaling Voyages, Several Variants, 1817–92 (percentages)**

Arrival Year	*N*	Including Capital Gains and Losses, Variant A	Excluding Capital Gains and Losses	
			Variant A	Variant B
		A. Annual Averages		
1817	7	16.6	17.1	13.4
1818	5	23.2	23.8	20.0
1819	7	11.8	12.5	6.8
1820	11	16.5	17.1	13.2
1821	10	15.3	15.9	11.3
1822	8	23.3	23.3	17.1
1823	23	7.3	7.3	4.4
1824	24	6.3	6.3	4.0
1825	15	35.5	35.4	25.6
1826	11	47.0	40.5	27.2
1827	23	30.6	28.6	19.9
1828	25	18.1	16.3	10.2
1829	26	13.5	12.0	7.2
1830	30	42.0	38.2	26.4
1831	32	17.4	18.0	12.7
1832	32	25.6	28.1	18.3
1833	34	46.4	49.6	21.9
1834	35	13.7	15.0	7.9
1835	46	0.7	1.7	0.2
1836	43	16.0	15.1	6.8
1837	53	10.6	8.8	3.9
1838	56	4.5	2.5	−0.5
1839	47	11.2	9.2	3.3
1840	41	21.3	19.3	9.7
1841	29	20.3	17.9	9.6
1842	48	11.2	8.7	3.9
1843	48	12.1	9.6	4.4
1844	71	24.8	21.6	12.5
1845	50	1.2	−1.2	4.7
1846	49	9.8	8.5	3.8
1847	61	3.2	2.8	0.4
1848	55	0.1	0.6	2.2
1849	47	9.2	9.7	4.5
1850	48	18.0	18.6	9.8
1851	71	35.0	37.0	19.1
1852	39	31.9	35.2	13.2
1853	78	8.7	12.4	4.2
1854	96	3.3	7.3	6.3
1855	72	7.7	11.1	5.7
1856	74	23.8	25.3	13.8
1857	94	5.8	5.7	6.5
1858	62	9.8	8.2	3.4

(continued)

Table 11.2 (continued)

Arrival Year	*N*	Including Capital Gains and Losses, Variant A	Excluding Capital Gains and Losses	
			Variant A	Variant B
		A. Annual Averages		
1859	68	12.8	9.7	6.0
1860	62	11.8	8.3	3.5
1861	71	7.2	4.3	−1.2
1862	60	4.1	5.5	0.5
1863	52	6.2	13.8	5.2
1864	69	35.1	46.5	11.9
1865	46	28.1	32.2	12.2
1866	28	16.0	18.9	11.2
1867	41	5.3	5.0	2.2
1868	39	10.8	9.0	2.1
1869	42	9.5	7.2	4.8
1870	44	0.2	−3.9	−4.6
1871	47	2.8	0.3	−2.1
1872	25	−0.7	−2.2	−3.9
1873	25	9.8	9.1	1.5
1874	24	17.0	15.9	5.3
1875	28	20.5	18.3	10.9
1876	26	30.1	23.4	12.3
1877	19	59.0	50.2	12.7
1878	33	14.5	6.2	3.1
1879	24	7.0	0.3	−1.4
1880	23	1.9	3.9	−0.2
1881	24	6.3	8.5	1.0
1882	22	13.9	19.8	3.2
1883	11	2.0	3.1	2.4
1884	14	8.9	6.1	1.3
1885	10	11.7	7.4	2.6
1886	14	7.8	3.1	0.1
1887	10	7.5	8.1	0.2
1888[a]	2	—	8.1	5.2
1889[a]	5	—	19.3	6.2
1890[a]	11	—	19.6	6.0
1891[a]	1	—	17.2	14.5
1892[a]	1	—	10.4	3.4
		B. Decadal Averages[b]		
1817–26		17.8	17.3	12.2
1818–27		19.3	18.6	13.0
1819–28		23.5	22.1	15.0
1820–29		19.7	18.5	12.6
1821–30		23.1	21.4	14.5
1822–31		22.7	21.3	14.5
1823–32		23.2	22.3	15.0
1824–33		27.5	27.0	16.7

Table 11.2 (continued)

Arrival Year	*N*	Including Capital Gains and Losses, Variant A	Excluding Capital Gains and Losses	
			Variant A	Variant B
		B. Decadal Averages[b]		
1825–34		27.8	27.5	16.8
1826–35		23.1	23.1	13.7
1827–36		21.7	21.8	12.6
1828–37		19.0	18.9	10.5
1829–38		17.4	17.1	9.2
1830–39		16.6	16.2	8.5
1831–40		15.1	14.8	7.3
1832–41		15.2	14.7	7.0
1833–42		13.6	12.7	5.6
1834–43		12.3	10.8	4.9
1835–44		13.3	11.4	5.4
1836–45		13.8	11.5	6.0
1837–46		11.6	9.5	5.0
1838–47		11.7	9.6	5.1
1839–48		11.5	9.6	5.5
1840–49		11.0	9.5	5.5
1841–50		10.9	9.5	5.5
1842–51		13.5	12.7	7.1
1843–52		15.8	15.4	8.3
1844–53		12.5	12.7	6.6
1845–54		13.5	15.1	7.7
1846–55		12.0	14.1	7.0
1847–56		13.2	15.2	7.7
1848–57		13.2	15.2	8.4
1849–58		14.6	16.5	8.8
1850–59		13.9	15.3	8.1
1851–60		13.8	14.8	8.0
1852–61		10.8	11.4	5.9
1853–62		9.4	9.9	5.1
1854–63		9.0	9.7	5.2
1855–64		12.5	13.7	5.7
1856–65		14.3	15.7	6.3
1857–66		11.7	12.6	5.0
1858–67		12.8	14.1	4.7
1859–68		14.3	15.9	5.3
1860–69		13.7	15.6	4.9
1861–70		12.8	14.8	4.3
1862–71		12.7	14.9	4.5
1863–72		13.0	15.2	4.5
1864–73		13.6	15.0	4.3
1865–74		9.8	9.0	2.8
1866–75		8.2	6.7	2.2
1867–76		9.5	7.1	2.3

(continued)

Table 11.2 (continued)

Arrival Year	*N*	Including Capital Gains and Losses, Variant A	Excluding Capital Gains and Losses	
			Variant A	Variant B
		B. Decadal Averages[b]		
1868–77		12.6	9.7	2.8
1869–78		12.5	9.0	2.7
1870–79		16.0	11.5	3.0
1871–80		13.9	10.5	3.2
1872–81		15.7	12.5	4.1
1873–82		17.3	14.6	4.8
1874–83		17.3	14.6	5.0
1875–84		16.2	13.0	4.6
1876–85		16.1	13.1	3.9
1877–86		13.4	10.9	2.4
1878–87		8.9	7.0	1.3
		C. Overall Averages		
1817–92		13.8	13.7	6.6

Source: Profits Data Set.

Note: Variant A rates are based on estimates of net reproduction cost investment, variant B on estimates of gross reproduction cost. See the text.

[a]The number of voyages refers only to the last two columns. The profit-rate variant including capital gains and losses cannot be calculated for voyages this year because necessary figures for vessel-construction cost are not available.

[b]Averages of the rates in panel A, weighted by numbers of voyages.

than in the case of variant B. Thus there are two explanations for the difference between the variants, and it is not surprising that the variant A profit rates are higher.

Since several factors influence the levels of the series, one should not expect that the two would necessarily move together, and their patterns of change are indeed somewhat different. For example, variant A is more volatile. Perhaps more interesting, the relative levels of the two series and their year-to-year movements vary from time to time. Compare the two sets of estimates for the years 1817–18 and 1852–53. These figures suggest the complexity of the connections between the two series; they are by no means related in a simple, linear way. If one is interested in the details of the profit record, such as the relative profitability of voyages returning in, say, 1849 and 1850, then it is necessary to consult both series. If one is interested in the broad patterns of change, the two series are more nearly interchangeable. For example, the timing of annual fluctuations in profit rates is very similar in the two series, and

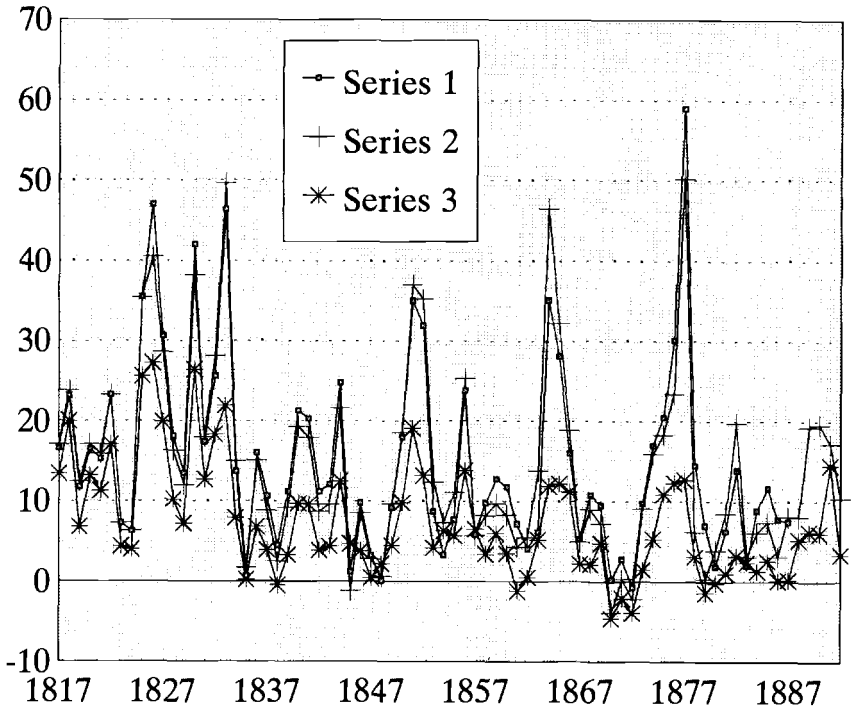


Fig. 11.1 Mean profit rates of New Bedford whaling voyages, 1817–92, three variants (1 = var. A, with capital gains, 2 = var. A, 3 = var. B)
Note: The text explains how the variants were computed.

the broad movements over longer periods are essentially the same. For treatment of the big picture, the two series seem equally useful.[16]

Apart from short-term fluctuations, the most interesting feature of table 11.2 and figure 11.1 is that they show, in the early years, high profit rates to be more common than low ones, while the reverse is true of the later years. For example, in fifteen of the first twenty years in the table, variant A profits were above the average for the entire period, 1817–92; in variant B, the proportion is seventeen out of twenty. Of the next fifty-six years, only nineteen were unusually profitable according to the variant A series, only fourteen according to variant B. During the first period the industry expanded very rapidly (see table 1.2); the profit-rate data are consistent with a standard view of profits in competition: high rates induced firms to enter, and the industry expanded. Eventually, something approximating competitive equilibrium emerged.

There is a question, however, as to the duration of the period of marked expansion. Merchant vessels could easily be converted into whalers. The capi-

16. The differences between the levels of variants A and B are important when returns in whaling are compared with returns in other industries. See below.

tal stock could, in principle, be expanded very rapidly. Why then did it take twenty years for the profit rate to fall to levels approximating a long-run equilibrium? The most plausible answer is that demand for the products of the whale fishery was growing so rapidly that, even with dramatic increases in the capacity of the industry, profits remained for a long time above the long-run equilibrium level. The data reviewed in chapters 2 (prices) and 9 (the growth of demand) are consistent with this interpretation. In any case, the process pictured in the table and figure does look very much like a long-term expansion toward equilibrium profit rates.

After the first twenty years (1817–36) profit rates fluctuated around an essentially unchanging level.[17] During the first part of this period—down to the mid-1840s—the industry was still expanding, then it stabilized for a time, then it contracted. A question immediately arises: if it took thirty years of high profits to expand the industry to its peak level, why didn't it take thirty years of losses to liquidate it? The profit rates after the mid-1840s were not as high as those in the earlier years, but they were not low by any other standard. There is the suggestion that the industry contracted at a pace that kept profits at a reasonable level. Firms got out of the industry at close to an optimal rate.

There are probably three explanations for this record. The first major contraction of the industry was forced, not by unfavorable returns (at least not of the usual sort), but by the Civil War—in particular the activities of Confederate cruisers and the assembly of the Stone Fleet. The cruisers demolished all the whalers they could find—which were many—and kept others from plying their trade outside the North Atlantic. Whaling agents sold their idle vessels to the government to be sunk at the entrances to Charleston and Savannah harbors in a largely futile attempt to obstruct entry and exit. Therefore, after the war the fleet was already smaller than it had been before the war. Profit rates were not sufficient to induce many firms that had left the industry to return. The big downward adjustment of the size of the fleet was occasioned by external forces, not by low or negative profits arising out of commercial conditions.

Later two events of a similar nature caused the fleet to shrink. In 1871 and in 1876 a substantial part of the Arctic whaling fleet was caught in the ice and destroyed. Once again, the decline took place without the impetus of market-induced low profit rates. In all three instances a fortuitous drop in supply helped to compensate for the effects on profits of a declining demand.

If these developments are not sufficient to explain the decline of the fleet in the absence of substantial market losses, perhaps the explanation lies in the fact that it was easier to liquidate the fleet than it was to create it. Vessels could be quickly converted to other uses. Most whaling agents and owners had a second string to their bow (see chapter 10), so that they could leave whaling to engage in some other pursuit. As for the seamen, their fate was probably not

17. See the decadal averages in table 11.2. The variant B series appears to drop again slightly toward the end of the century.

the foremost concern of owners and agents. In any case, the corps of seamen had begun to shrink long before the industry was wound up. The Civil War and Arctic losses were the events that left the seamen adrift, if anything did.

The hunting grounds were opened at various dates. Economic theory suggests that profit rates must have been higher in the new grounds initially, but that, as time passed and more vessels moved into them, rates in the various grounds must have converged.[18] In the years just after the War of 1812, both the Atlantic and the Pacific were being hunted; the Indian Ocean was reopened somewhat later, and the Western Arctic opened later still.[19] One would expect to find the profit rates of vessels returning from the Indian Ocean or Western Arctic to be relatively high at first, but eventually to drift downward toward the rates being earned in the Atlantic and the Pacific.

Such a convergence is, indeed, what the record shows (see table 11.4). Before the Civil War, vessels returning from the Indian Ocean had higher profit rates than those returning from the Atlantic in twenty-two of the twenty-eight years for which the comparison can be made. For vessels returning from the Western Arctic, rates were higher than those earned in the Atlantic in nine of ten years before the war. After the war there are clear indications that the advantage of the newer grounds had been eliminated. In the thirty-one instances in which a comparison can be made between the Atlantic and one of the other two grounds, the higher rate was earned in the Atlantic in seventeen, in the other ground in fourteen. Again, there is a strong suggestion of an adjustment process at work.

One feature of these data is puzzling. On the whole the Pacific was the least profitable ground of all. For example, in fifty-three of the seventy-two years in which a comparison can be made, vessels returning from the Atlantic had the higher profit rate.[20] Since the Pacific was the newer ground, one might expect it to register higher rates, at least in the early years; but it is in the early years that the comparison with the Atlantic is especially unfavorable.

Narrowing the focus to the period in which the Pacific was the main hunting ground produces a somewhat different impression. Down to the late 1830s the Atlantic was the ground more often hunted. In the early 1840s the number of voyages to the Atlantic declined and the number to the Pacific expanded. By

18. The convergence would be incomplete if risks varied by hunting ground. A test of the following form was run to check this possibility, as well as the possibility that risk changed over time. The variance of the profit rate divided by the mean was regressed on time and hunting-ground dummies, with the results in table 11.3. The fit is very poor and the significance levels are low.

19. The Indian Ocean was hunted by New Bedford vessels as early as 1793, but relatively few voyages were made, and between 1810 and 1830 only four.

20. The reader may recall that the regression reproduced in table 8.2 shows that productivity was higher in the Pacific than in the Atlantic. How is it, then, that profit rates were *lower* in the Pacific? The explanation is that the productivity comparisons were made holding many other variables constant, which is not the case for the profit-rate comparisons. Introducing profit rates as dependent variables in regressions of the form of the one in table 8.2 yields results similar to those in table 8.2—that is, profit rates in the Atlantic are shown to be lower than those in the Pacific, ceteris paribus.

Table 11.3 **Regression of Profit Rate Divided by the Mean, on Time and Hunting-Ground Dummies**

	Coefficient	Prob > | *T* |
Intercept	−0.0539	0.939
Ground 1	0.9104	0.161
Ground 2	0.1473	0.838
Ground 4	−0.0257	0.978
Time	0.0045	0.751

Notes: Prob > F = 0.658. Adjusted R^2 = −0.0077.

1844, for example, the Atlantic returned only four vessels to New Bedford, while forty-two came back from the Pacific.[21] In this later period the profit rates of the two grounds are more nearly comparable. Particularly important is that between 1844 and 1864—the heyday of the Pacific, when the ground returned between twenty-seven and sixty-three vessels to New Bedford annually—the average annual profit rate of Pacific vessels was greater than that of Atlantic vessels in ten of the twenty years that comparisons are possible (table 11.4). The two grounds seem to have been at parity during this period.[22] The relatively new Indian Ocean hunting grounds continued to be more profitable (as did the Western Arctic), recording higher rates than the Pacific in eleven years between 1844 and 1864.

The industry experienced in expansion, then brief stability, and finally a contraction that appears to have been negotiated without severe commercial losses. Hunting was redistributed among the various grounds in response to profit-rate differentials. Given this evidence, can an equilibrium profit rate be identified? Consider the possibilities.

First, perhaps the profit rates earned in the years during which the industry neither expanded nor contracted should be regarded as equilibrium rates, since there is, in the evidence on the size of the industry, a suggestion of equilibrium. The average rate (variant A) for this period—1846 through 1860—is about 14.9 percent, compared to a 13.7 percent average rate for the full period, 1817–92.

Second, perhaps equilibrium profits can be identified with a period of zero trend in the profit rate. From the decade 1837–46 until 1892, the decadal aver-

21. The data on voyage numbers cited in this paragraph differ slightly from the data in table 11.4. The text data refer to all voyages; the table 11.4 data refer to voyages for which profit rates could be produced.

22. A possible explanation (partial) for the relatively poor performance of the Pacific has to do with measurement error. Although we intended to include in output all the oil and bone shipped home in advance of a vessel's return to New Bedford, it is likely that the data on shipments are incomplete. Since Pacific voyages were typically longer and therefore led to relatively more product's being shipped home than did Atlantic voyages, the failure to count all output shipped home in advance would probably have a bigger effect on the profit rates of voyages to the Pacific than of those to the Atlantic. We do not believe that the problem is a serious one, however.

Table 11.4 **Mean Annual Profit Rates of New Bedford Whaling Voyages, by Hunting Ground, Variant A (excluding capital gains and capital losses in vessels), 1817–92 (percentages)**

Arrival Year	Atlantic[a]	*N*	Indian	*N*	Pacific	*N*	Western Arctic	*N*
1817	42.7	2		0	6.9	5		0
1818	28.7	4		0	4.4	1		0
1819	6.4	6		0	49.0	1		0
1820	20.5	8		0	7.9	3		0
1821	40.8	3		0	5.2	7		0
1822	14.4	4		0	32.2	4		0
1823	16.9	4		0	5.2	19		0
1824	28.1	12		0	−15.4	12		0
1825	47.4	11		0	2.5	4		0
1826	48.9	8		0	18.1	3		0
1827	49.4	9		0	15.3	14		0
1828	25.1	16		0	0.5	9		0
1829	13.9	15		0	9.4	11		0
1830	46.2	17	95.0	1	22.1	12		0
1831	30.7	14		0	8.1	18		0
1832	32.8	21	33.8	1	17.7	10		0
1833	71.5	21		0	14.3	13		0
1834	26.0	12	25.3	1	8.5	22		0
1835	15.7	16	−6.7	4	−5.5	26		0
1836	21.7	22	−8.0	1	9.0	20		0
1837	15.0	25	21.3	6	−1.7	22		0
1838	1.5	30	32.0	4	−1.4	22		0
1839	8.9	12	19.9	12	3.7	23		0
1840	20.3	7	28.2	13	13.5	21		0
1841	27.5	4	36.6	7	8.5	18		0
1842	10.7	9	21.3	17	−1.8	22		0
1843	−18.6	3	28.3	12	5.3	33		0
1844	23.3	3	34.7	31	10.4	37		0
1845		0	20.6	15	−10.6	35		0
1846	−2.6	4	25.0	11	4.5	34		0
1847	−10.9	2	12.4	11	1.1	48		0
1848	12.6	3	12.1	9	−2.7	43		0
1849	−7.0	1	13.6	12	8.8	34		0
1850	−23.8	1	18.7	10	19.7	37		0
1851	61.3	2	27.6	10	36.9	57	62.0	2
1852	9.6	2	31.4	9	29.4	27	275.1	1
1853	−24.9	7	10.1	13	16.8	46	19.7	12
1854	7.1	14	14.7	11	2.4	49	14.6	22
1855	−8.5	5	8.9	6	12.4	45	14.5	16
1856	13.8	7	16.6	9	23.9	45	42.6	13
1857	−9.3	4	−1.8	13	4.1	61	21.4	16
1858	7.1	5	9.7	10	2.3	32	20.0	15
1859	−1.0	2	13.9	10	7.7	45	15.7	11
1860	19.7	1	4.6	7	8.0	43	10.5	11
1861	35.5	10	−2.8	11	−1.4	38	2.9	12
1862	29.6	7	9.9	9	−0.2	28	2.6	16

(continued)

Table 11.4 (continued)

Arrival Year	Atlantic[a]	*N*	Indian	*N*	Pacific	*N*	Western Arctic	*N*
1863	17.6	14	5.2	6	9.8	26	30.7	6
1864	165.7	20	−3.7	11	−2.9	36	21.6	2
1865	47.8	23	12.5	3	17.2	20		0
1866	32.3	10	17.4	5	−1.8	9	34.1	4
1867	6.0	20	13.5	3	1.8	9	3.0	9
1868	12.8	18	6.4	4	9.5	10	0.0	7
1869	3.4	11	12.9	5	7.1	18	9.0	8
1870	−9.9	14	−3.1	7	−0.3	17	−0.9	6
1871	11.0	7	0.2	9	−4.1	21	1.9	10
1872	−4.9	7	−1.8	8	−3.7	8	12.2	2
1873	35.5	7	0.8	6	−2.1	12		0
1874	91.6	4	4.3	9	−2.3	11		0
1875	40.2	10	−2.8	7	4.1	8	32.4	3
1876	31.8	12	22.2	3	14.5	8	14.3	3
1877	73.9	12	−1.5	2	14.0	5		0
1878	5.9	20	−5.2	5	5.3	7	74.5	1
1879	−2.2	11	1.2	6	3.4	7		0
1880	6.4	14	3.1	2	−1.1	7		0
1881	9.7	14	0.0	1	−2.8	8	90.2	1
1882	21.2	11	−2.6	1	8.8	8	67.0	2
1883	−3.9	9		0	66.1	1	3.0	1
1884	4.5	11		0	12.3	3		0
1885	8.3	6		0	6.1	4		0
1886	9.4	7		0	−3.3	7		0
1887	14.6	6		0	−1.6	4		0
1888	11.1	1		0	5.2	1		0
1889		0	21.5	2	17.9	3		0
1890	23.9	4	33.0	4	−4.0	3		0
1891		0		0	17.2	1		0
1892	10.4	1		0		0		0

Source: Profits Data Set.

Note: The means are unweighted.

[a]Atlantic voyages include voyages to Hudson Bay and Davis Strait.

age profit rates seem to fluctuate around a stable level, suggesting that the industry might have been in something roughly approximating equilibrium. True, early in the period the industry was expanding, and toward the end it was contracting; but these changes did not greatly affect the general level of the profit rate. During this period the average variant A rate was almost 12 percent, compared to the 14.9 percent rate for the years 1846–60 and the 13.7 percent rate for the entire period.

There is yet a third criterion. The equilibrium rate might be thought to be the one earned during the years in which the reallocation of effort to newer hunting grounds was over—that is, in the period in which the new hunting grounds no longer enjoyed a profit advantage. These were the years following

the Civil War, and the variant A rate earned during this period (1866–92) was about 9.7 percent.

The three averages range, then, from 9.7 to 14.9 percent; the variant B estimates would be about one-half as large. These figures, however, are very much affected by extreme values. A better estimate of the approximate level of the equilibrium rate might be obtained from the median. As is to be expected, the median rates cluster closer together: 1846–60 = 9.7 percent, 1866–92 = 8.1 percent, and 1846–92 = 8.9 percent. Rounding these numbers gives a range of 8 to 10 percent for the equilibrium rate, which may very well bracket the true rate. The equilibrium rate excludes excess profits, of course, but it includes not simply the costs of Knightian uninsurable risks, but also returns to knowledge and unusual skill. (Schumpeterian returns to innovation should be part of the disequilibrium profits.)

How the components of the equilibrium rate should be separately identified in quantitative terms is not clear. The data set, however, does contain evidence on the profits earned on voyages managed by the various whaling agents. Some sense of the range of experience by firm can be obtained from these data. Thus, the scale on which agents were rewarded for knowledge and skill—as well as for persistent, successful innovation—might be judged.[23]

Profit rates varied widely from voyage to voyage, partly due to luck. Furthermore, many agents stayed in the business only a short time. If one is interested in returns to knowledge, skill, and innovative activity, it is only sensible to explore the records of agent firms that managed many voyages, and to look at their average experience rather than at the results of individual voyages. Presumably self-selection and accumulated experience made these agents the repository of special knowledge and skills. If they stayed in the business for long, they must at least have kept up with innovations.

Table 11.5 reports the profits on the voyages managed by those twenty-nine agents who organized at least forty voyages. These agents were an important group: they accounted for over one-half of the voyages in the Voyages Data Set, and well over one-half of the voyages for which profit-rate estimates can be made. The first and third columns contain two sets of calculations: the average profit rate earned on the voyages the firm managed throughout its entire history, and the ratio of that rate to the average rate earned by all the firm's whaling competitors in the years in which it had vessels returning to New Bedford.

All of these firms but two averaged positive profits on all their voyages. That is, each of these firms—except the two—managed to pay competitive rates of

23. The estimates of profits for each individual voyage are only rough approximations to true profits, of course, and therefore the results obtained for individual agents are also only approximations to what is required. Regardless of these considerations, however, the very striking results obtained for the individual agents seem secure. See the earlier sections of this chapter for a treatment of the methods by which profit estimates were made, as well as a discussion of the shortcomings of the estimates.

Table 11.5 **Average Profit Rates Earned on Voyages Managed by New Bedford Whaling Agents Who Organized at Least Forty Voyages, Variant A (excluding capital gains and capital losses in vessels), 1817–92**

Firm	Profit Rate (%)	Coefficient of Variation	Ratio of Column 1 to Profit Rates of Competitors[a]	Relative Fees[b]	Total Number of Voyages[c]	Number of Voyages in Computation[d]
Gideon Allen; Gideon Allen & Son; Gilbert Allen	59.2	644	4.44	+	94	64
John P. Knowles II	35.9	331	2.98	+	47	39
Edward W. Howland	21.5	142	1.93	+	50	42
George Howland; George & Matthew Howland	20.5	208	1.48	+	119	98
Abraham H. Howland	18.5	150	1.40	0	40	26
Edward C. Jones	18.4	136	1.88	+	81	61
Frederick Swift; William C. N. Swift & Eben Perry; William H. Aiken & Frederick Swift	17.9	233	1.87	+	131	68
Henry Taber & Co.	17.6	126	1.06	−	47	36
Charles H. Gifford; Gifford & Cummings; William Gifford	17.3	248	1.27	−	50	35
Charles W. Morgan	15.5	123	1.06	−	60	54
Isaac Howland Jr. & Co.	14.7	184	0.97	−	171	145
Samuel Rodman; Sylvanus Thomas & Co.; Sylvanus Thomas & William F. Dow	14.6	248	0.98	+	59	42
Abraham Barker	12.4	157	1.01	−	43	30
Alexander Gibbs	12.0	136	0.93	−	49	30
Joseph & William R. Wing	11.8	240	1.08	−	236	76
Jonathan Bourne; Jonathan Bourne Jr.	11.8	240	0.94	+	147	102
Benjamin B. Howard	11.5	273	0.74	+	46	32
Jireh Perry	11.2	287	0.93	−	43	33
Jireh Swift Jr. & Frederick S. Allen	10.5	200	0.83	−	88	62

John Avery Parker; John Avery Parker & Son	9.4	283	0.67	–	97	62
Charles R. Tucker; Charles R. Tucker & Co.	8.4	317	0.66	–	112	89
James B. Wood & Co.	8.4	190	0.52	–	61	46
Thomas Knowles; Thomas Knowles & Co.	7.7	312	0.55	–	95	79
Ivory H. Bartlett; Ivory H. Bartlett & Son; Ivory H. Bartlett & Sons	7.4	763	0.54	+	95	26
Loum Snow; Loum Snow & Son; Thomas Cook & Loum Snow	7.1	280	0.54	–	59	32
William Lewis; William Lewis & Son	4.6	693	0.27	–	153	16
Matthew Luce; William Hathaway Jr.; William Hathaway Jr. & Matthew Luce	4.4	305	0.27	–	45	41
Thomas & Asa R. Nye; Thomas R. Nye Jr.	−2.3	−4,126	—	+	80	67
David R. Greene & Co.	−2.5	−5,371	—	+	46	33
Mean, all voyages	13.7					
Mean, all voyages managed by agents who organized fewer than forty voyages	10.7					
Total					2,444	1,566

Source: Profits Data Set.

Notes: Agencies that changed names but exhibited continuity with respect to the principal members of the firm were treated as one firm. For example, the three firms, Charles H. Gifford, Gifford and Cummings, and William Gifford, were treated as one firm.

[a]For each voyage managed by a firm for which a profit rate can be calculated, the mean profit rate for all voyages agented by competing firms that arrived in the same year was computed. The entries in this column are the ratios of the means of the subject firms' profit rates to the means of the means of the competitors' rates. For example, say an agency managed three voyages, ending in 1820, 1820, and 1822. Its profit rates on these voyages were 10.2, 18.1, and 5.6. In 1820 the profit rates of its competitors' voyages averaged 8.1, in 1822, 7.5. The subject firm's mean profit rate would be 11.3. Its competitors' would be 7.9. The ratio would be 1.43 (11.3/7.9).

[b]The fee-earning ability of the named agency compared to the abilities of all other agencies that had vessels returning to New Bedford in the same years.

[c]Each entry gives the number of voyages in the Voyages Data Set that the agent managed, during the course of the life of the agency.

[d]Number of voyages for which profit rates could be (and were) calculated.

Table 11.6 **Profit-Rate Distributions for Voyages Managed by the Leading Twenty-Nine Firms and All Other Firms, New Bedford Whaling Voyages, 1817–92 (percentages)**

	Leading 29 Firms	All Other Firms	Total
Loss rates			
≥−25%	2.5	1.9	2.2
<−25%	29.6	35.8	32.3
Profit rates			
0 to <10%	22.2	21.7	22.0
10% to <20%	16.3	14.8	15.7
20% to <40%	16.7	13.2	15.2
40% to <60%	7.0	6.6	6.8
60% to <80%	3.3	2.4	2.9
80% to <100%	1.0	1.5	1.2
≥100%	1.5	2.0	1.7

Source: Profits Data Set.

interest to investors, competitive fees to agents, and an average rate of profit on capital ranging, among firms, from almost 4.5 percent to almost 60 percent. Unless whaling firms were very risk-averse indeed, these firms must be regarded as successful. The top nine or ten were extraordinarily successful; words fail one, when the record of Gideon Allen and his son is considered. Could that figure be right? Could Allen et fils really have taken home almost 60 percent, on average, for sixty-four voyages, in addition to the fees they earned as agent and the interest return on capital invested? It seems so.

The meaning to be given the profit record of Gideon Allen—and for that matter David Greene, the Nyes, Ivory Bartlett, and William Lewis—must be tempered, however, by a recognition of the variability of the voyage rates and the skewedness of the distributions. All of the voyage profit-rate distributions are skewed—usually to the right—and all exhibit considerable variability (see table 11.6). But those recorded by Allen, Greene, the Nyes, Bartlett, and Lewis have extraordinarily large coefficients of variation, as compared with the other firms in this group (see table 11.5).[24]

The unusually large coefficients of variation reveal the existence of pronounced outlier voyages, yielding unusually large profit or loss rates. All have two characteristics in common: they were short voyages carried out by elderly vessels. Since they were short, the net investments in subsistence items for the crew and outfitting expenses were small; that is, the value of these items consumed on the voyage was small. Since the vessels were old, their net (depreciated) reproduction costs were low. Total investment in each of these extreme outlier voyages was therefore small.

In several instances an outlier voyage was short because some disaster—for

24. The coefficients of variation are also large compared with virtually all of the rest of the firms represented in the Profits Data Set.

example, the death of the captain—brought the vessel quickly back to port. Vessels returning within a few months of setting out were unlikely to bring home much, if anything, in the way of output. The investors suffered losses that, perhaps not large in absolute terms, were large compared with the investment in the voyage. Thus, loss rates of 100 percent or more were recorded.

Some short voyages, however, were short not because of disaster, but because of striking success. For example, Gideon Allen's *Milwood* returned in 1864 after six months at sea with a catch valued at $172,841. Of the 1,566 voyages underlying the data in table 11.5, only 24 returned with output valued at more than $172,841. The shortest of them took 30 months; the longest was 103 months; twenty-two took 40 months or more.

The *Milwood*'s achievement, then, was very great. She was an old vessel (fifty-eight years); the investment in her outfitting costs was very little; her operating costs for six months were slight; and she brought back an unusually valuable cargo. The profit rate on this voyage—by far the highest profit rate in the data set—was over 3,000 percent.

The large loss and profit rates on short voyages are real enough and deserve to be taken into account, but they tend to obscure the day-to-day level of success achieved by the outlier firms. In the cases of these firms—the five with unusually large coefficients of variation—it is helpful to look at other indexes of central tendency. For example, although Gideon Allen's average profit rate far exceeds the rates of the other four, this is not true of his median or trimmed mean rate (table 11.7). His mean weighted rate (weighted by voyage duration) is higher than the averages of the other four agents, but well below his unweighted average rate. David Greene and the Nyes, whose unweighted average rates are negative, both have positive rates according to all of the other mea-

Table 11.7 **Profit Rates Earned on Voyages Managed by Five Leading Nineteenth-Century New Bedford Whaling Agent Firms, Measures of Central Tendency (percentages)**

	Mean	Median	Trimmed Mean[a]	Mean, Excluding Voyages < 6 Months	Mean, Weighted by Voyage Duration
Gideon Allen; Gideon Allen & Son; Gilbert Allen	59.2	4.9	5.7	61.4	16.7
Ivory H. Bartlett; Ivory H. Bartlett & Son; Ivory H. Bartlett & Sons	7.4	5.5	5.4	13.3	9.3
William Lewis; William Lewis & Son	4.6	−1.4	−1.0	4.6	4.2
Thomas & Asa R. Nye; Thomas R. Nye Jr.	−2.3	9.1	7.3	13.3	8.6
David R. Greene & Co.	−2.5	17.3	15.2	19.5	14.4

[a]The mean of the set of profit rates lying within the interquartile range.

sures. It is clear that, leaving aside a few outlier voyages, four of the five firms performed in roughly comparable fashion. William Lewis by all accounts was less successful than the rest. The outlier voyages cannot be ignored, but neither should their results be regarded as typical of the performance of these firms.

There is a second respect in which comparisons among the average profit rates recorded in the first column of table 11.5 are not entirely legitimate. The firms did not operate over precisely the same periods of time; their profit rates are therefore not fully comparable. The third column of the table contains estimates put together to deal with this problem. It compares the average rate of profit of each agent across the career of the firm with the profit rates earned by the other agents operating in the same period of time. The rankings change little. The differences among firms apparently were not much affected by the time periods during which they operated.

Agents were subject to divided loyalties. Owners—and agents as owners—did best if profits were maximized. But agents as managers did best if the value of output was maximized, since their fees depended importantly on this variable. Agents may well have been biased in their managerial practices in the direction of extending the duration of the voyage in order to maximize the value of output—perhaps at the cost of the profit rate. If that were the case, agents who seem to have been relatively unsuccessful, against the standard of profits, might be shown to be more successful if fees were factored into the account.

The fourth column of table 11.5 indicates whether firms did better than (+), worse than (−), or just as well as (0) their competitors in earning fees per voyage. The strong suggestion is that the firms earning the highest profits also did unusually well with fees.

Although these data give no indication that agents with relatively weak profit-rate records were able to recoup by manipulating voyages to maximize output and thus fees, there is some evidence that an output-maximizing motive played a role in determining the behavior of agents. The evidence is drawn from a sample of 239 voyages. Enough information concerning these voyages is available to analyze the relationship between voyage length and the agent's investment share. The most obvious area in which the interests of agents and owners might come into conflict is voyage length. An agent who had invested little might be tempted to keep the vessel at sea longer than the optimal time, since extending the voyage would be the principal way in which output could be augmented. An agent who had invested much would presumably be less tempted to extend the voyage to increase returns from fees.

To test this proposition, the following regression was run:

$$\begin{aligned}\text{voyage duration} = a &+ b \text{ agent's share in the investment} \\ &+ c \text{ ground dummies} + d \text{ time} \\ &+ e \text{ the tonnage of the vessel.}\end{aligned}$$

Table 11.8 Determinants of Voyage Duration

	Coefficient	Prob > |T|
Intercept	36.635	0.0001
Agent's investment	−4.189	0.1597
Atlantic[a]	−16.385	0.0001
Indian[a]	−2.907	0.2299
Western Arctic[a]	−2.109	0.2926
Time	0.079	0.1699
Tonnage	0.013	0.2710

Source: Profits Data Set.

Notes: F value = 17.714. Prob > F = 0.0001. Adjusted R^2 = 0.2964.

[a]Comparison base = Pacific.

The ground dummies and the time and tonnage variables were intended to take into account the chief determinants of voyage duration, apart from luck and the output-maximizing tendency of the agent.[25] The results are presented in table 11.8. The sign on the coefficient of the variable *agent's investment* is consistent with the idea that the strength of the output-maximizing motive was inversely related to the share of the voyage owned by the agent. The effect is not large, however. On average the voyage of a vessel completely owned by its agent was, ceteris paribus, only about four months shorter than the voyage of a vessel of which the agent owned only one-thirty-second. The significance level is also not high. The regression provides only a modicum of support for the view that the power of the output-maximizing motive was greater, the smaller the investment share of the agent.

To return to the main point to be taken from table 11.5, it is clear that the issue treated early in this chapter—the qualification of the competitive situation by the differing knowledge, skills, and innovative activities of agents—is important. The Howlands, the Swifts and Perrys and Aikens, John Knowles, and Edward Jones knew something valuable, and it was knowledge that was not widely shared. As to the rest of these agents who frequently sent vessels to sea, their records do not look so good in comparison with the records of their peers. But remember, their peers included such extraordinary businessmen as John Knowles and the rest of that able lot. Placed against another standard, most of the agents who fail the test of relative performance still did very well. Most of them paid their investors a competitive rate of return, paid themselves substantial fees, and earned for themselves and the other owners attractive profit rates.

The very successful members of this group of experienced agent firms were clearly earning returns to knowledge and skill, or Schumpeterian returns to innovation, or both. How important were these returns when compared with

25. Voyages of brigs, schooners, and sloops were eliminated from the sample. There were few of these voyages, and there were special circumstances influencing their duration.

average rates of return in the industry? A lower-bound estimate can easily be computed. The average rate of return (variant A) of all the voyages in the Profits Data Set, *except* for those managed by agent firms that ran at least forty voyages and that also earned an average rate of return greater than the industry average (13.7 percent), is 10.7 percent.[26] That is, excluding from the calculation those firms that most obviously earned returns from special knowledge and from innovation, the average rate of return for the industry drops by 3.0 percentage points, or about one-fifth.[27] Compared with the probable equilibrium profit rate of between 8 and 10 percent, the extra returns of the exceptional firms bulk even larger, averaging between 30 and almost 38 percent of the equilibrium rate.

Finally, and both most appropriate and most impressive, the average rate of return (weighted by number of voyages) of the leading dozen agents was almost 11 percentage points higher than the returns of the firms against which they directly competed. The figure would be much higher if the calculations included among competitors only firms that were not themselves among the top dozen.

It should be clear, then, that returns to special knowledge, exceptional skill, and innovative activity, taken together, were substantial. At the very least they accounted for one-sixth of total returns. Additionally, if equilibrium profits did run between 8 and 10 percent, as previously suggested, excess profits must have averaged between 3.7 and 5.7 percent, across the entire period (overall average rate of profit of 13.7 percent, minus the estimates of equilibrium profits). A reasonable guess would divide profits among sources in roughly the following way:

Excess profits:	
(13.7 minus 10.0 equals)	3.7 percent
or	
(13.7 minus 8.0 equals)	5.7 percent
Returns to knowledge, skill, and innovation:	
(13.7 minus 10.7 equals)	3.0 percent
Payments for bearing uninsurable risk and uncertainty:	
(13.7 minus [3.7 plus 3.0] equals)	7.0 percent
or	
(13.7 minus [5.7 plus 3.0] equals)	5.0 percent.[28]

26. To compute this figure, average profit rates were weighted by voyages, rather than by years or investment.

27. Excluding the record-setting voyage of the *Milwood,* the industry average is 12.5 percent, and the margin over the average rate of profit of the body of the industry is 1.8 percent.

28. Omitting the voyage of the *Milwood,* the figures would be:

(12.5 minus 10.0 equals)	2.5 percent
or	
(12.5 minus 8.0 equals)	4.5 percent

Finally, how do the rates of return to whaling investment compare with those in other lines of activity? One would expect rates to vary from one type of business to another, reflecting differences in business risks, in the degree of control over the market exercised by firms, in the information possessed by the various firms in each industry, in the extent to which firms engaged in successful innovative action, and in the relationship between the observed figure and the equilibrium rate of profits in each activity. The simple comparison of rates of return is not likely to take one very far toward conclusions of historical importance. As Gavin Wright (1973, 5) puts it, "[T]here is an irreducible inconclusiveness about specifying 'correct' or 'competitive' rates of return in a world of uncertainty." Establishing the extent of market imperfections and the effects of innovations is also difficult. The problem is compounded because the rates that are available for comparison refer to a few isolated years, so that the question of the state of the market—the extent to which it deviates from long-run equilibrium—is especially important. Finally, rates available for other industries rest on earnings data that combine all property returns—rents, interest, profits—and frequently some managerial salaries. If the whaling figures are to be juxtaposed to data for other industries, either the former must be augmented by estimates of the returns—other than profits—to all property, or net profit rates must be derived for the other industries. It is easier and safer to augment the whaling data.

As is well known, the measured nineteenth-century rates of return were higher in manufacturing and railroading than in agriculture (see table 11.9).[29] The usual interpretation of this result is that it represents a true difference—that is, a difference that produced a relative expansion of the two more profitable sectors and a relative contraction of the third. There are at least four other interpretations, all of which are typically mentioned in treatments of this subject.

First, farmers were engaged in a very close approximation to perfect competition, whereas most manufacturing firms, large and small, and all railroads participated in markets characterized by substantial control on the part of the sellers. The same situation may have existed with respect to steamboats on

Returns to knowledge, skill, and innovation:	
(12.5 minus 10.7 equals)	1.8 percent
Payments for bearing uninsurable risk and uncertainty:	
(12.5 minus [2.5 plus 1.8] equals	8.2 percent
or	
(12.5 minus [4.5 plus 1.8] equals)	6.2 percent

See also the roughly consistent results in table 10.14, panel C. The profit rate involved in the calculations of table 10.14 is variant B, whereas the one discussed in the text here is variant A. Variant A rates are always higher than variant B rates.

29. Most of the data refer to accounting profits, but, as Atack and Bateman (1990, 3–4) point out, "recent studies show accounting profit to be an acceptable proxy for the internal rate of return."

Table 11.9 **Rates of Return for New Bedford Whaling and Various Industrial Sectors, Nineteenth Century (percentages)**

	1850	1860	1870	1880	Nineteenth Century
Manufacturing	15.4	23.7	32.9	14.9	21.7[a]
Agriculture					
North		8.0		10.3	9.2[a]
South, cotton		9.7–10.0			
Steamboats					
Trunk	8.5				
Tributary	24.1				
Central Pacific Railroad					13.4[b]
New Bedford whaling	15.2–24.0	9.0–13.7	1.2–1.7	4.6–8.7	11.7–18.9[c]

Sources: For whaling rates see the text. Rates include profits and imputed interest. Other rates come from Atack and Bateman 1990, tables 2, 4, 5, 6, 8, 12.

[a]Averages of figures in the table.

[b]Private unaided rate of return, 1863–1908.

[c]Averages of 1817–92.

tributaries—that is, small markets dominated by a few firms. One would expect to find higher profit rates in these sectors than in agriculture. The same consideration must be borne in mind when whaling returns are compared with those from manufacturing, railroads, and steamboats on tributaries.

Second, the rates of return in manufacturing are biased upward, because the returns attributed to property include some managerial salaries and because interest costs were estimated on the basis of eastern market data, and no allowance was made for the higher interest costs prevailing in other parts of the country.

Third, it is possible that levels of business risk differed by sector. For example, whaling may have been riskier than agriculture, manufacturing, railroading, and steamboating, although that is by no means certain.

Finally, profit rates varied from year to year. For example, in 1880 the profit rate in whaling was substantially lower than that in manufacturing; if the whaling data for 1877 are substituted, whaling becomes very much more profitable than manufacturing. The whaling data refer to only one industry in one town. Thus whaling's profit rates could be expected to be more volatile than those of agriculture or manufacturing—large economic sectors spread over wide areas—if not of steamboating or railroading. The manufacturing rate, however, was also highly volatile, according to the limited information available: it fell by more than one-half between 1870 and 1880 (see table 11.9). Clearly, comparisons should not be drawn among single-year estimates, but among averages computed across many years of experience.

Unfortunately, the data are not rich enough to permit such comparisons. The

evidence reported in the last column of table 11.9 is the closest possible approximation to the required information. It appears that the profit rate in whaling was, on average, higher than that in agriculture, perhaps chiefly because whaling was the riskier industry, but perhaps also because it experienced expansion during part of this period.[30] The whaling rate was also probably higher than the rate enjoyed by the Central Pacific Railroad, the effects of the greater risk and disequilibrium profits in whaling overbalancing the effects of the monopoly position of the Central Pacific. In contrast, the average measured rate in manufacturing seems to have been somewhat higher than that in whaling. The manufacturing estimate may be biased upward, and manufacturers may have enjoyed some monopoly profits.[31] Perhaps most important, the estimate for whaling probably represents something closer to the equilibrium rate than does the estimate for manufacturing. The latter sector was expanding rapidly throughout the period—a fact suggesting that substantial excess profits were being made.

In summary, the data on profits indicate that the New Bedford whaling industry was in disequilibrium from 1817 through the late 1830s: profit rates were persistently high and new firms were induced to join the industry. As the market moved toward equilibrium, the fleet continued to expand, but at a more sedate pace. At times, additions to the fleet were made too rapidly, the profit rate temporarily fell, and growth came to a brief halt. Tendencies toward a more fundamental downward adjustment appeared in the late 1850s. They were dramatically accentuated by the activities of the Confederate Navy during the Civil War. Contraction continued in the postwar years, but by the end of the 1860s the timing of the decline in the fleet fit market requirements so closely that profit rates held up. Overall, whaling profit rates seem to have been somewhat higher than returns in other comparable industries, presumably because business risks were higher among the whalers.

Profit rates varied with productivity and the state of the market. Agents who stayed in the business for extended periods almost always did well, of course, in the sense that they paid all costs, including implicit interest on the investment of the owners and generous fees to themselves, and also turned a profit. There were wide differences in the average rates of return earned by the various agent firms, even if comparisons are drawn exclusively among firms that were

30. Lee Craig (1993, 82) has made estimates of the net profit rates in farming in census year 1860. These rates are probably conceptually comparable to our variant A estimates. He reports average farm profit rates of 10.4 percent in the Northeast and 9.7 percent in the Midwest. These figures are substantially higher than our variant A rate for 1860 (see table 11.2), but lower than our average for the full period.

31. The bias, if there is any, arises from the fact that some managerial wages are probably included in manufacturing profits. Atack and Bateman (1990, 35, 38) believe that they have more than compensated for the presence of managerial wages in profits and that their estimates of profit rates are actually biased *downward.*

in the business for many years. Presumably these differences reflect rents to special knowledge and rewards for innovative activity.

Knightian normal profits seem to have run no more than 5.0 to 7.0 percent per year, and excess profits, no more than 3.7 to 5.7 percent, while returns to special knowledge, special skills, and innovative activity came to at least 3.0 percent per year.