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The negative trade-off between risk and incentives: Evidence from the american whaling industry

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ABSTRACT

This paper analyzes the trade-off between risk and incentives in the share contracts of the American whaling industry. Using a newly collected panel of 5378 individuals who sailed on more than 1000 whaling voyages from 1855–68, the response of sailors' compensation to an increase in risk is estimated. The risks used to identify this response resulted from the commerce-raiding naval vessels of the Confederacy during the Civil War. As the Confederate cruisers sailed primarily in the Atlantic, and therefore posed far less of a threat to whaling voyages to other oceans, a quasi-experimental approach focusing on the differences between Atlantic voyages compared to others is implemented. The results are consistent with a negative trade-off between risk and incentives in the industry's contracts. Moreover, evidence is found of selection among less risk-averse sailors and merchants into riskier voyages during the war.

1. Introduction

Among the many unique institutions of the American whaling industry was its mode of compensating its crews, known as the "lay." The industry's merchants, who resided in small ports in the northeastern United States, sent their vessels to distant oceans, where the crews had to perform many difficult and dangerous tasks, including some "too horribly nauseous for description."[1] In response to the moral hazard problems inherent in their relationship with their crews, whaling merchants compensated them with incentive contracts, wherein every crewmember was given a share or "lay" of his vessel's output; as an eighteenth-century merchant wrote, "we have our men on shares that all the men on board may have an interest in the success of the voyage."[2] Although the surviving contracts of the whaling industry have been studied extensively (see, for example, Davis et al. (1997) and Hohman (1928)), many of their properties—and in particular, the extent to which voyage risks influenced the crews' shares—have never been analyzed.

In the standard theory of contracts, compensation systems must balance the conflicting objectives of risk sharing and the provision of incentives. Considerable research has tested for the implied negative trade-off between risk and incentives in contracts from a variety of contexts, both in the present and in history. In general, the results of this literature have been ambiguous and contradictory; in many cases, evidence of a positive relationship has been found.[3] However, as a few recent contributors to this literature have noted, the trade-off between risk and incentives is difficult to identify empirically, because changes in the level of risk may induce changes in other determinants of contract terms. For example, Ackerberg and Botticini

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[1] Nordhoff (1895, p. 129). The processes of "cutting in"—flensing the blubber from the carcass of a dead whale—and "trying out"—rendering the oil from the blubber—entailed many such nauseous tasks. A detailed narration of these processes is presented in Browne (1846), who compared the shipboard scene of trying-out to "Dante's pictures of the infernal regions" (p. 63).

[2] Coffin (1773).

[3] See, for example, Allen and Lueck (1999). Chiappori and Salanie (2003) and Prendergast (2002) provide detailed surveys of this literature.

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(2002) argue that the riskiness of an enterprise may be correlated with the characteristics of the agents who self-select into that enterprise, while the model of Prendergast (2002) shows that risk may influence the extent of delegation between firms and employees, which may, in turn, influence the optimal choice of incentives. The ambiguous nature of the evidence on the relationship between risk and incentives may be due to these other responses to risk, rather than to a failure of the theory itself.

This paper investigates whether the employment contracts of the nineteenth-century American whaling industry exhibited the negative trade-off between risk and incentives posited by contract theory. The surviving contracts of the industry present a unique opportunity to analyze this issue carefully, and to address the identification problems faced by much of the prior literature. The labor contracts of whaling voyages recorded the identity, rank, and the share of output of each crewmember, along with the identity of the merchant who sponsored the voyage. The analysis of this paper exploits the repeated observations of individual sailors and merchants on voyage contracts over time, so that the effect of changes in risk on the crewmembers' compensation can be identified in a panel data framework with sailor-specific and merchant-specific effects. As individual sailors often enlisted as crewmembers on vessels managed by many different merchants over their careers, these sailor and merchant effects can be estimated separately. The effect of self-selection among the industry's principals (merchants) and agents (sailors) in response to risk can therefore be isolated, and compared to those predicted by theory. The dataset collected for this paper includes all extant labor contracts from American whaling voyages departing in the years 1855–68, for a total of 1156 voyages managed by 168 merchants, and includes 5378 different individuals, who served in the managerial ranks on board. Data describing the vessels, crews, and output of the voyages in the dataset were obtained from customs records to investigate other potential responses to risk, such as changes in the size or configuration of the vessels employed.

The time span of the dataset encompasses a period of elevated risks for many whaling voyages: the American Civil War. During the war, the Confederacy sent out naval cruisers in pursuit of the commercial vessels of the Union, including its whalers. The Confederate cruisers threatened the livelihoods, but not the lives, of the crews of whaling vessels, and when they captured a ship they would usually burn it with everything on board, while keeping its crew safe from physical harm. The naval efforts of the Confederacy thus created a new source risk for whaling voyages. However, the extent to which the many whaling voyages of the war years faced these risks varied substantially. In particular, the Confederate raiders sailed primarily in the Atlantic Ocean, which exposed whaling voyages in the Atlantic to the risk of capture to a much greater extent than those cruising in other seas. The identification strategy of the paper focuses on measuring the impact of this increase in risk using a difference-in-differences approach: the change in the difference between shares paid on Atlantic voyages and other voyages during the Civil War (compared to the pre-war and post-war periods) is computed.

The form of the incentive contracts used in nineteenth-century whaling resembles those envisaged by standard models of contracting under moral hazard, with a share of output, plus some additional compensation, negotiated prior to the voyage. The implications from theory for the response of these contracts to an increase in risk are therefore clear: the crews' shares of output should have decreased, and the fixed component of their pay should have adjusted to compensate for their lower expected compensation. It should be emphasized that these ex ante compensation contracts present a more direct test of the predictions of contract theory than those of many studies using modern data, where the response of ex post compensation to ex post measures of risk has been analyzed.

The results of this paper are consistent with the existence of a negative trade-off between risk and incentives in whaling employment contracts: in response to the greater risks of the Confederate cruisers, the shares paid to crews on Atlantic voyages fell relative to voyages to other destinations, while a guaranteed component of their compensation, which came partly in the form of advances at the beginning of the voyage, increased.[4] These results are robust to the inclusion of fixed effects for the individual crewmembers and merchants in the dataset, and the biases resulting from excluding these fixed effects from the analysis are consistent with self-selection among less risk-averse crewmembers and merchants into riskier Atlantic voyages during the war. Moreover, the perceived risks associated with the Confederate cruisers in the Atlantic, which varied over the course of the war, can be quantified using marine insurance data. The results indicate that the year when the relative war risks of the Atlantic were perceived to be highest (1863) was also the year in which the relative shares paid on Atlantic voyages fell the most.

This paper's emphasis on distinguishing incentives from selection contributes to a much broader literature that seeks to disentangle these effects empirically in a variety of contractual settings. For example, Lazear's (2001) analysis of performance pay finds that the ability, as well as effort, of a firm's workforce is a function of its compensation contracts. And in work that parallels the analysis of the risk-incentive trade-off presented here, Finkelstein and McGarry's (2006) study of insurance contracts shows that unobserved agent characteristics such as risk aversion may empirically confound the positive correlation predicted by theory between the extent of coverage and risk occurrence. Finally, Abramitzky (2006) finds that both moral hazard and negative selection have been important determinants of the membership, and contracts, of Israeli Kibbutzes.

Although the American whaling industry and its contracts have been the subject of considerable economic research, the experience of whaling during the Civil War has not been analyzed carefully.[5] Moreover, none of the earlier datasets of whaling

[4] These advances were effectively loans against the wages to which the crews would be entitled from their shares of output. However, if the crews did not earn wages sufficient to repay their advances (for example, because the voyage went poorly or because a Confederate cruiser captured their vessel) then these advances were not repaid. See Section 7 below. As no systematic data is available on value of the other components of the crews' compensation, such as the room and board provided, it is not known whether these changed as well.

[5] Among the many notable contributions to the study of whaling are Ellickson (1989), Hohman (1928), Allen and Keay (2004), Craig and Fearn (1993), and Davis et al. (1997). The latter study's large sample of whaling voyages excludes the Civil War era.