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The Economics of Political Participation and Distribution in Fisheries Management

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by

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September, 2016

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Abstract

The Economics of Political Participation and Distribution in Fisheries Management

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Economists have characterized efficient policy remedies for market failures, but inefficient institutions persist. Efficient institutions fail to emerge due to high transaction costs in policy formation, political constraints (in private ordering), and misaligned incentives. Similarly, reducing the "transaction costs" and time required to create and implement regulations requires knowledge of the behavioral responses of stakeholders to proposed policies. I examine political and behavioral explanations for the persistence of inefficient management using a mix of theoretical and empirical approaches.

The first chapter of my dissertation "Empirical Evidence on the Economics of Stakeholder Opposition to Fishery Rights-Based Management" is an empirical analysis of the resource users' response to the proposed implementation of Individual Tradable Quotas (ITQs) in the Alaskan Sablefish and Halibut Fisheries. I examine the role of stakeholder participation in the formation of fisheries policy, and how fisher characteristics can be used to predict their position on policy adoption. Chapter two, "The Decision to Participate: The Role of Influence and Cost in Stakeholder Participation in the Formation of the Public Policy." is a collaboration with Paulina Oliva from UCSB Economics Dept. This chapter addresses what motivates individuals to participate in the political process of natural resource management. The final chapter of my dissertation "An Empirical Examination of the Downstream Effect of Fishery Rationalization on Communities" is very complementary

to chapter one in that it asks the questions: what are the downstream effects of rights based management?; and is this an explanation for opposition? This paper is a collaboration with Eric Edwards at Utah State.

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Abstract:

Economists have characterized efficient policy remedies for market failures, but inefficient institutions persist. When changes in policy also result in a change in distribution of wealth, even the most efficient policies can be politically infeasible. In many settings, successful policy adoption requires a trade-off between efficiency and distribution. In a common pool resource setting, the transition to secure, tradeable property rights can be economically beneficial and improve the health of the resource, but is often met with resistance. Individual transferrable quotas (ITQ), have encountered a considerable amount political opposition despite their well-documented improvements of harvesting efficiency and fishery health. This paper provides an empirical examination of the role of distributional concerns that influence an agent's preference for a proposed change in the Alaskan sablefish (blackcod) and halibut fisheries. I construct a data set of consisting of nearly 4,000 public political participation records regarding ITQ implementation in the Alaska halibut and sablefish fisheries. I use a novel individual level dataset of public comments and catch data to test whether fishers who show that the allocation of catch influences whether a person or entity is in favor of the policy.

"There are still ocean cowboys around who feel this is the last frontier. They think that anybody should have a right to fish, no matter what it does to the resource and whether or not it makes good economic sense." – Walter Pereya, Seattle Seafood Processor[1]

I. Introduction

Economists have characterized efficient policy remedies for common pool resources (taxes, cap and trade, etc.), but inefficient institutions persist. When changes in policy also result in a change in the distribution of wealth, even the most efficient policies can be politically infeasible. As a consequence of distributional concerns, policy design tends to trade-off between efficiency and distribution. In the context of implementing property rights based management for natural resources (e.g. fisheries, pollution), the initial allocation of rights may not impact economic efficiency (Coase, 1960), but can have a significant impact on distributive equity amongst stakeholders and therefore could influence whether or not the policy is adopted.

Many environmental and natural resources remain characterized by insecure property rights and open access conditions despite large potential gains from increased institutional control. One of the most extreme examples of inefficient resource use is in fisheries, where there are an estimated $50 billion in losses worldwide each year (Costello et al. 2016). A 2004 study by the FAO (2009) found that better management could alleviate losses by up to 50% of current fishery revenues (via Arnason, 2012).[2] As of 2015, there were 15 property rights based management programs in place in the United States (NMFS, 2015), but many

[1] May 11, 1989. San Jose Mercury News.

[2] The study by the World Bank and FAO (2009) found that in 2004 the global ocean fishery operated at a significant net economic loss financed in part by government subsidies.

fisheries are still managed using command and control methods. Many fisheries are managed under regulated open access conditions where rules restrict season length, gear type, and other methods of harvesting. These types of rules have been characterized as "regulation by inefficiency" because they promote a race to fish wherein overcapitalization is combined with high-cost and dangerous fishing practices. There is compelling and increasing evidence that property rights based management, the movement of a fishery to Individual Transferable Quotas (ITQs), improves both the economic and ecological health of a fishery (Arnason 1997; Grafton 1996; Dewees 1998; Danielsson 2000; Clark 1980; Costello, Gaines, and Lynham 2008). Yet inefficient management persists.

The difficulties of transitioning out of an inefficient management regime are linked to the cost of the process by which a new institution is created and adopted (Libecap 1989; 1993). A large amount of political resistance can result in delays or even stop the policy formation and adoption process. Political resistance to cap and trade policies, like ITQs, can be disaggregated into three main stages: capping, allocation, and trading (Heinmiller, 2007). The primary focus of this paper is political resistance at the allocation level. Understanding the distributional issues that determine opposition may allow policymakers to better design politically feasible property-rights based resource management programs.

In the context of US fisheries, decisions about resource management are mandated by the Administrative Procedure Act to incorporate stakeholder input (Turner et al, 2005).[3] It is

[3]The Administrative Procedure Act requires that all U.S. federal regulatory agencies "shall give interested persons an opportunity to participate in the rulemaking through submission of written data, views, or arguments with or without the opportunity for oral presentation" (Title 5 U.S. Code Section 553(c), 1988 edition). In Corrosion Proof Fittings v. Environmental Protection Agency (1991) the Supreme Court showed its willingness to require that public opinion be adequately consulted. (In this case, the court vacated proposed

apparent that political opposition has halted or delayed many resource management programs in the United States. When Congress reauthorized the primary law governing fisheries management in US federal waters, the Magnuson-Stevens Act (MSA, 1976) in 1996, political pressure from the processing industry and other equity concerns led to the issuance of a 6-year moratorium on the creation of new ITQ programs (Guide to U.S. Environmental Policy). Prior to the MSA reauthorization, Alaskan Pollock harvesters attempted to strengthen the institutions governing the fishery, but political protests from processors halted any new or pending plans to change management regimes in a way that allocated rights to individual harvesters.

In the formation of some of the earliest US ITQ programs, concern for small-scale fishermen and the takeover of fisheries by big business were cited as reasons for opposition. The concern has been publically acknowledged as a potential outcome from ITQs in congressional testimony.[4] Public opposition to ITQ systems is not limited to the United States. The Icelandic Cod Quota system, implemented in 1983, resulted in sweeping concentration of the fleet and the public naming the quota holders "Lords of the Sea" (Helgason, 1996). In Canada, opposition to ITQs has been so strong that one parliamentary

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regulation because the Environmental Protection Agency prematurely ended public hearings and deprived the public of sufficient opportunity to "comment [on], analyse, and influence the [regulatory] proceedings"

[4]Rolland Schmitten. Assistant Administrator for Fisheries at the National Marine Fisheries Service in answering questions in congressional testimony in 1994: "Do ITQs promote 'big-business' as large companies have resources to buy or lease a significant amount of shares? This could happen, as experienced with grocery stores, agriculture, and other such enterprises… To the extent that larger firms are relatively better capitalized, they may be able to obtain more shares relative to their needs for efficient operation than could smaller firms."

committee in Ottawa went so far as to argue that evidence for New Zealand and Australia's ITQ systems shouldn't be used to justify Canada's use of ITQs (Mctaggart et al. 2003).

This paper explores the economics of political resistance to ITQ adoption. In changing the property right allocation from the status quo, some users may see net losses even if the overall gains are large. Other users do not foresee future losses but instead see opportunity to increase their share by holding out. These users may delay or prevent the adoption of a welfare-enhancing institution (Matulich and Sever, 1999). While this has been the case in the evolution of many ITQ programs in the United States and other countries, there is limited understanding of the specific economic factors which determine stakeholder position on ITQ and other property rights based management programs.

Prior research shows how ITQ design affects the distribution of benefits among and within sectors (Matulich and Sever, 1999; Costello and Grainger, 2015; Costello, 2015). This paper tests whether the distribution of benefits explains opposition using data from the adoption of the Alaskan Halibut and Sablefish ITQ program. The adoption of the Alaskan Halibut and Sablefish ITQ in 1995 culminated fourteen years of deliberations. As such, the program development process was noted as being "enormously complicated and controversial" with "extremely painful" deliberations (Pautzke and Oliver, 1997). In both fisheries, quota was allocated based on historic catch. Given the same catch pre- and post-ITQ, a harvester is expected to be at least as well off, in terms of catch, under the ITQ regime. Allocation is contentious when harvesters do not believe the initial allocation formula provides them an equivalent catch in the future as would occur under status quo management. For instance, individuals with inconsistent participation history in a fishery

may receive an initial quota lower than what was actually caught in any year in which they participated.

This paper links political opposition due to allocative concerns to fisherman characteristics: parties from remote communities, harvesters with high volatility in landings, and low volume fishermen. ITQ programs were implemented in the Alaskan Halibut and Sablefish fisheries simultaneously in 1995. I exploit differences in the locations and characteristics of harvesters and other stakeholders to disentangle the underlying economics of opposition. I construct a unique dataset by coding available public comments made between 1987 and 1992. Public comments are in the form of oral testimony and written communication. This time period captures the initial reaction to the ITQ management proposals and is the time period where all major modifications were made to the ITQ/fishery management plan. The names of commentators are linked to individual characteristics, including location, vessel ownership and landings data. The combined data are used to statistically test the role of participation history and location in determining levels of support for ITQ implementation. Results show that being a vessel owner increases the likelihood of being in favor of ITQs by 30 percentage points, while being located in a remote location decreases likelihood of being supporting ITQs by about 30 percentage points. Larger harvesters are more likely to be in favor of ITQs and variation in annual landings is negatively related to ITQ support.

Identifying and quantifying the underlying reasons certain harvesters, remote community members, and industry members may lose under certain policy designs can assist in the design of management institutions, reduce the amount of opposition and the length of time to implementation, and improve overall implementation efficiency. Understanding

opposition allows policy to be designed to achieve a variety of social goals. For instance, to achieve the most effective design incorporating benefits to fishing communities, rights can be allocated to fishing cooperatives or fishing ports, rather than to individual fishermen (Costello, 2014). In this paper, I demonstrate how the institutional setting in which policy is implemented affects the distribution of benefits and hence political support. This paper highlights the trade-off between efficiency and distribution necessary to achieve political feasibility.

The paper is organized as follows: Section II provides background on ITQs and the role of public input in the formation of fisheries management in the United States; Section III provides a detailed breakdown of the distribution of costs and benefits and develops testable predictions; Section IV describes the data and empirical design; Section V provides the results of the statistical analysis; concluding remarks follow.

I. Background

Changes under Fishery Rationalization

The implementation of ITQs has been linked to political opposition attributable to the redistribution of rents under the new regime (Matulich et al 1996). The fisheries examined in this paper transitioned to ITQ management from regulated open access management. Under regulated open access management, command and control regulations, such as vessel size restrictions, gear restrictions, and season limitations dominate. Such regulations result in a "derby style" fishery associated with a great deal of inefficiency as well as safety concerns. A derby fishery is typically characterized by a large, and often times unrestricted, number of vessels operating during a short time period. As more vessels enter the fishery, regulators shorten the season to avoid overfishing. The consequences of derby fishing on safety are

severe: "[p]eople went out in bad weather, boats were overloaded, and crews worked to exhaustion (Woodfurd, 2016)."

One of the major steps towards property rights based management of a fishery is determining who has the right to fish. Similar to cap and trade programs aimed at controlling pollution, harvesting rights are typically allocated by grandfathering where harvesters receive a certain percentage of that year's catch based on average historic catch. When a grandfathering scheme is used, allocation is contentious because individuals prefer the time period when their harvest levels were greatest (Grainger and Parker 2013).

The adoption of property rights hinges on the acceptance by the resource users and other stakeholders. As stated by Hanneson (2004): "those who expect to gain will promote the new institution, those who expect to lose will fight with equal or greater vigor." Stakeholders demand a voice in the process of defining and allocating rights, which often times results in "delays, ambiguities, and transaction costs (Colby, 2000)," but the extent to which distribution determines a stakeholder's position has been largely overlooked in economic literature.

Overall efficiency gains associated with ITQs are large, but vessel owners may oppose if they prefer alternative management techniques or believe they will fare better under status quo management. As Costello and Grainger (2015) point out, the inframarginal rent enjoyed by high skill resource users may, upon the transition to property rights, be capitalized into asset values and transferred to all permit owners. However, they also find that as long as the initial allocation is at least 30% of historic catch, all users will be better off. Guyader and Thebaud (2000) find that many harvesters have preferences for input regulations such as

gear restrictions, which are perceived to give equal opportunity to all participants and award the most skillful.

This paper suggests that opposition to ITQs can be traced to the institutional setting in which individual fishing quota is allocated and the resulting distribution of benefits. Grandfathering of quota results in relatively lower gains (or even losses) to vessel owners with inconsistent vessel landings. When quota is grandfathered, newer participants or participants missing a year or more of fishing, will receive a percentage of quota lower than their actual catch in any given participating year. Individuals displaying higher variation in annual landings due to exogenous shocks (broken arm, etc.) may feel their allocation under grandfathering is not reflective of their actual skill level. Both absent and inconsistent vessel owners may object to or delay property rights adoption until the calculation of quota share reflects internal beliefs about future landings potential. In other words, a harvester may try to delay ITQ implementation if she thinks average harvest will increase over time, and past harvest is not reflective of future potential harvest.

Differential valuation of expected future catch by individuals relative to the grandfathering allocation scheme is analogous to the process of unitizing oil fields. Oil lease production is influenced by firm management policies, details of which are not publically available. This leads to internal calculations of lease value that differ from value calculations that are made using publically available data. If a firm believes the estimated lease values calculated using public information are too low, or that delay will reveal new information leading to a larger allocation, the firm will object to unitization (Libecap & Wiggins, 1985). In the case of the fishery, if a vessel owner believes historic landings data is not reflective of future earning potential, the vessel owner may object to and delay rationalization. Libecap

and Wiggins (1985) also point out that a firm may resist joining if holding out will result in concession from other parties.

Community Incentives

ITQs can result in changes in fleet size and the timing and location of landings. When landings move from one port to another, factor markets must also move. Many remote Alaskan communities serve as factor markets for the fishing industry, providing fish processing, boat and dock services, and points of sale for fish. Most economic analysis of fisheries management has assumed that individuals act as autonomous agents, maximizing profit under budget constraints (Guyader, & Thebaud, 2000). However, residents of coastal communities worry about the effect of fleet consolidation on non-harvesting employment and economic activity (Reimer, Abbott, Wilen, 2013 8, 16-19). ITQs generate rents through the elimination of excess capital and consolidation of harvest to the most efficient vessels (Reimer, Abbott, Wilen (1-4)). Fleet consolidation results in a reduction in the total number of crew jobs, although the remaining jobs are more consistent and over a longer season (Abbott & Wilen, 2010). The Canadian Halibut fishery experienced a reduction in the number of crew employed on active vessels and a consolidation of the fleet after ITQs were implemented. These two effects resulted in a 32% decrease in employment (Abbott & Wilen, 2010).

The degree to which adverse impacts may occur depends on the relative importance of the fishery to the community's local economy (Stewart, 2006). Many small communities rely on the small-boat fleet and processing industry as a source of local employment. Jobs created by local fishery resources include crew positions, as well as downstream fishery industries including cannery production, and vessel equipment, supply and repair business.

Members of small communities participating in Alaskan fisheries may receive allocations of fishing rights in line or above historic harvest levels, but the concern for coastal communities persists, particularly those in remote rural areas.

Fisheries Management and Public Input

Public input plays an important role in the formation of US fishery regulation. In the United States, regional fishery management councils have considerable power in fishery management decisions. The methods used by fishery councils to make decisions and solicit public comment provide the key data source for this paper and here this process is discussed in detail. The North Pacific Fishery Management Council (NPFMC), which regulates the Alaskan sablefish and halibut fisheries, consists of eleven voting members including seven private citizens—five from Alaska and two from Washington— appointed by the Secretary of Commerce from lists submitted by the Governors of Alaska and Washington.[5] Council members appointed by governors may have electoral accountability if reappointment to the council is dependent upon public satisfaction with their performance, and this can result in council members voting for politically favorable or neutral policies.

The fishery management council makes decisions under the authority of the Magnuson-Stevens Act (1976). The council is able to modify and create a fishery management plan (FMP) for fisheries within its jurisdiction. FMPs characterize the way a fishery is managed and changes to management (amendments) are considered by the council at each meeting. The council composition is designed so that all stakeholder groups are represented. Meetings are open to public comments—written, emailed and oral—and council decisions are made

[5] The council also includes four non-voting members representing the Pacific States Marine Fisheries Commission, the U.S. Fish and Wildlife Service, the U.S. Department of State, and the Coast Guard.

by recorded vote in a public forum. After the council has voted, the final decision is sent for a second review to the Secretary of Commerce. The Secretary receives further public comment, and if approved, the Council makes the decision final.[6] Minimum time for regulatory change is over a year, with duration increasing if the regulation is complex or contentious. In the United States, the incubation period for ITQ policy has ranged anywhere from 1 year to 17 years (author's calculations). In the late-1980s and early-1990s the NPFMC floated proposals for ITQs for five fisheries under their jurisdiction: halibut (1988) and sablefish (1987); Bering Sea and Aleutian Island crab (1991); Pollock (1990); Non-Pollock Groundfish (1991); and Rockfish (1991). These proposals were opened to public comment and comments were solicited via meetings and letters until ITQ adoption. The first ITQ scheme was adopted in the halibut and sablefish fisheries in 1995.

Individual Transferrable Quotas (ITQs) were first proposed as potential management methods for Alaskan Sablefish and Halibut in 1987 and 1988, respectively[7]. ITQs offer net gains to resource users, but face pushback from the general public, vessel owners, and industry members. The contentious nature of the ITQ policy resulted in an eight year lag between policy proposal and its implementation. Stakeholders voiced their position on ITQ management at council meetings, through phone-calls, petitions, and written letters. In the time period studied, the fishery council met in Anchorage five times per year and received input from a variety of advisory groups including the science and statistical committee

[6] All rules and policies must conform to the Magnuson-Stevens Act, Endangered Species Act, Marine Mammal Protection Act, Regulatory Flexibility Act, the National Environmental Policy Act, executive orders, and other applicable law.

[7] Though limited entry had been contemplated since 1981 (NPFMC, 1997).

(SSC), Advisory Panel (AP) and "plan teams" on the proposed fisheries policy. The AP consists of members representing user groups, recreational fishermen, environmentalists, and consumer groups.

Between 1987 and 1992, official council meetings were held exclusively in Anchorage although scoping meetings were held in other cities in Alaska and Seattle. The meeting structure is determined by an agenda that is posted by the council. The public may propose changes to regulations by testifying to the AP or making a comment to the Council during the public comment period. These comments may be made in person at the meeting or by writing. At each meeting, the council members and staff receive a briefing book, which contains summaries of background information for each agenda item, reports and materials for each item, and written public comment. Between 1987 and 1992 the council received over 3000 letters and signatures from vessel owners and other interest groups stating their preferences regarding the ITQ policy.

Halibut and Sablefish ITQ: Management History and Policy Design

Commercial harvest of Halibut can be traced back to the early 1900s, and the fishery mostly produced fresh-fish until the 1970s (Homans & Wilen, 2000). Higher halibut prices in the 1970s and the implementation of limited entry programs for salmon fisheries contributed to the growing number of vessels entering the halibut fishery. During the 1980s, the fishery experienced an influx of many larger vessels from crab fisheries as crab stocks declined (IPHC 1987). Even as the total allowable catch stayed steady or increased, the season length shortened due to increased entry (FAO, 2009). The halibut fishery

experienced growth when other fisheries experienced low years, and the relatively low cost of entry into the fishery also made the halibut attractive as a "supplemental" fishery.

Halibut and sablefish fishermen often overlap, as both require use of longline gear and similar vessels. However, sablefish are harvested further off the coast at depths of 400m, requiring larger vessels and more specialized gear than halibut harvesting. Halibut are a flatfish caught in waters as shallow as 90 feet, allowing vessels as small as skiffs to harvest halibut close to shore. Sablefish vessels are on average larger than halibut vessels, and a few large vessel operators target exclusively sablefish. Most of these fishers operate vessels 60 feet or more in length, enabling them to fish in less-protected areas, such as the Bering Sea and Aleutian Islands (FAO, 2009).[8]

Pre-ITQ command and control regulations resulted in a race to fish in which vessels and gear are chosen to maximize quantity harvested in a short time period (Homens & Wilen, 2000). This derby setting was particularly dangerous if the season opening happened to occur during inclement weather. Non-participation on bad-weather days would result in missing an entire season. Between 1980 and 1988, an average of 31 individuals died at sea (ADFG, 2016)[9]. In 1993, the mortality rate for Alaskan fishers was 34.8 per 100,000 workers, which was 7 times the national occupational average (CDC, 1993).

The council responded to the rapid growth and overcapitalization of the early 1980s halibut fishery by proposing a moratorium on entry into the fishery. The moratorium was the first limited entry policy proposal for Halibut, and was recommended by the NPFMC to the Secretary of Commerce for review under the authority of the Northern Pacific Halibut Act

[8] http://www.fao.org/docrep/005/y2684e/y2684e22.htm

[9] http://www.adfg.alaska.gov/index.cfm?adfg=wildlifenews.view_article&articles_id=757

of 1982. Regulations recommended by council must be approved by the Secretary of Commerce, acting through NOAA and National Marine Fisheries Service (NMFS) before they become law. Secretarial review, which considers federal policies and stances on management approaches, precedes publication of proposed federal regulations.

The public had mixed reactions to the proposed halibut limited entry management, and the policy underwent substantial scrutiny by federal reviewers. In 1983, the Office of Management and Budget (OMB) ruled the proposed halibut limited entry regulation to be inconsistent with Executive Order 12291[10]. Though the council directed a "plan team" to continue to examine limited entry for the halibut fishery, the proposal was abandoned in 1985 and the fishery, along with its inefficiencies, continued to grow.

Similarly, the sablefish fishery attracted an increasing number of vessels from 1980 to 1990. The council first adopted allocative measures for sablefish in 1985, when the total allowable catch was split between geographic areas and gear types (NPFMC, 1997), but the advent of new fishing technology, increasing vessel size, and increased entry led to further growth of the sablefish fishery. Between 1985 and 1990 the number of sablefish harvesters grew from 371 to 800, and problems manifesting in the halibut fishery, such as shortened season, congestion externalities, and racing for fish, also plagued the sablefish fishery. The eastern Gulf sablefish season decreased from 180-days in 1984 to 20 days by 1990; the Central Gulf fishery decreased from a 254 day season in 1984 to a 60 day season in 1990 (Pautzke and Oliver, 1997).

The Council began reviewing sablefish license proposals in 1987 and conducted several industry surveys. In the summer of 1987, the Council called for sablefish management

[10] http://www.archives.gov/federal-register/codification/executive-order/12291.html

proposals, and, in the fall of 1987, adopted a Statement of Commitment declaring the Council's intent to pursue alternative management methods for the sablefish fishery including strategies for license limitation or individual transferable quotas (ITQs). In 1988, the council voted that status quo management was not an acceptable policy and directed its staff to create five alternative sablefish management plans. In January 1988, the council directed its staff to specifically analyze ITQs and license limitations alternatives, and the final ruling on the preferred management method was scheduled for June 1988. ITQs were a contentious topic in council meetings, and many Alaskan vocally opposed the policy. The council's final decision on a preferred management option was repeatedly postponed. In 1989, the fishery management plans were further reviewed at a public hearing, and three plans were selected for review and refinement over the next two years.

In 1990, ITQs were selected as the preferred management for sablefish and the council also elected to include the halibut fishery in the implementation of the sablefish ITQ policy. By this time, there were already area and gear restrictions in place for both species, but the policy as proposed in 1990 would undergo many changes before the final version would be selected as the preferred management alternative. Many of these changes specifically address distributional concerns highlighted by harvester and stakeholder input. Between 1988 and 1992, over 1,000 vessel owning halibut and sablefish harvesters expressed their position on the proposed ITQ policy to the Council and many voiced concerns over distributional impacts of ITQs on small operations, new harvesters, and small communities. More than 2,000 other members of the general public participated in the policy formation process by speaking at council meetings, writing letters, and signing petitions.

The ITQ program was anticipated to distribute the total allowable catch of halibut and sablefish. Each participant would receive quota based on documented catch from 1984 and 1990. Newer entrants to the fishery would receive substantially less than they currently were catching, while others would receive more than their current average catch. According to council analysis of quota recipients of shares, 5,484 halibut vessel owners would be given shares in the initial allocation of quota. The number of vessel owners participating in the halibut fishery grew from 2,479 in 1985 to 3,883 in 1990. For sablefish, the annual number of vessel owners ranged from 244 in 1985 to 706 in 1988. In total, 1,094 vessel owners received sablefish shares in the initial allocation process.

Changes were made to the ITQ plans of both species to address distributional concerns, and the preferred ITQ policy was selected in the end of 1991. The structure of the ITQ policy varied slightly by species, but the programs were implemented simultaneously. Both species were allocated by area, and shares were initially allocated to vessel owners and leaseholders making at least one landing between 1988 and 1990 (NPFMC, 1997). The three year eligibility window was intended to account for exogenous negative shocks such as sickness, vessel damage, or the Exxon Valdez oil spill, which may have caused a fisher to be absent in a given year. The initial grandfathering of quota for sablefish was calculated using the best five of six harvest years for 1985 through 1990, and the best five out of seven years for 1984 through 1990, for halibut (NPFMC, 1997).

III. Predictive Framework

Stakeholder characteristics expected to influence level of support for ITQ policy include vessel ownership, stakeholder location, and production characteristics. According to the ITQ policy design, individuals owning and leasing vessels that participated in the sablefish and

halibut fishery receive quota share, a sellable asset, but crew, processors, and other industry members receive no quota share. The quota holder is expected to receive a greater share of the ITQ benefits relative to non-quota holding stakeholders. The first prediction of this paper:

Prediction 1: Vessel ownership increases the probability a stakeholder is in favor of ITQs.

The extent to which vessel ownership influences position on ITQs likely depends on the location of the stakeholder. Stakeholders in small, remote Alaskan communities have fewer local employment alternatives outside of fisheries. There are three common justifications for why remote communities may expect to benefit less from ITQs than their non-remote counterparts, beyond factors related to quota allocation: (i) individuals from remote locations may anticipate reduced market access; (ii) the wellbeing of the individual's community may be a consideration (Carothers, 2000); (iii) the "culture" of remote locations may be one that mistrusts government or resents government control (Karpoff, 1985). The processing of fresh fish requires access to major port towns as fish are highly perishable and need to be flown to their final destination using commercial passenger planes (Interview with Trident Seafood). Processors located in remote areas will not be able to access the fresh market, but will be required to compete with fresh fish processors for raw materials. Remote community members could easily anticipate a diversion of fish away from their ports, as most fishing communities were aware of the changes that occurred when the BC halibut fishery rationalized a few years prior. There, the season lengthened from 5 days to 8 months and the amount of product sold to the fresh market increased from 42% to 94% (Casey, 1992). Additionally, congestion externalities associated with the derby fishery may be less

severe in remote locations due to inaccessibility of fishing grounds. For these reasons, the prediction 2 relates to the location of the vessel owner or stakeholder:

Prediction 2: Remote harvesters and stakeholders are more likely to oppose ITQs

The second part of the predictive framework focuses on distributional impacts to vessel owners. Larger firms may be less sensitive to a quota share lower than expected catch, because they internalize more of the benefits of the more efficient institution (Wiggins and Libecap, 1987). Relative to a small operation, larger operations are expected to experience greater gains from ITQs through decreased coordination and investment costs. Higher average landings may indicate greater investment in the resource and hence more stake in the long-term stability of the resource. The following prediction summarizes this argument:

Prediction 3: Opposition to ITQs will be decreasing in average quantity of fish landed.

Support for ITQs is expected to be increasing in annual landings and decreasing in harvesting volatility. I build upon the earlier work on oil field unitization by Wiggins and Libecap (1985, 1987) and develop a simple, testable model of a harvester's decision to oppose or support property rights in a fishery setting. When deciding whether or not to support property rights, the vessel owner maximizes the expected value of her quota with respect to the date ITQ begins, t_r. The vessel owner will decide her position on ITQ implementation by calculating the difference between expected earnings under ITQ and status quo. Let $E[PV_i^{ITQ}]$ and $E[PV_i^{SQ}]$ be harvester i's expected present value of earnings under ITQ management and status quo management, respectively. If at any given date in the future the difference in vessel owner's expected present value of income under ITQ management and status quo management is greater than zero, the vessel owner will be in

favor of rationalization at this time. That is, a vessel owner favors rationalization at time t* if and only if:

$$E\left[PV_i^{ITQ}(t^*)\right] > E\left[PV_i^{SQ}(t^*)\right]$$

An individual's expected future catch is based on catch history during years active in the fishery (i.e. if he chose not to fish one year, this year would not be used in calculating expected catch when participating). Individual *i's* expected future catch is based on an average of catch during participating years. h_i^t is the actual harvest in time t, and T_i is the set of all years where $h_i^t \neq 0$, then expected catch is:

$$(1)\ EC_i = \frac{\sum_{t \in T_i} h_i^t}{Y_i^t}$$

where Y_i^t is the number of years individual *i* participated in the fishery at year *t*.

The general quota calculation is a function both harvester *i's* participation history and that of all other *N* participants:

$$(2)\ EQ_i = \frac{\sum_{t \in T_i} h_i^t}{\sum_{i=1}^{N} \sum_{t \in T_i} h_i^t}$$

Given an expected quota allocation EQ_i, individual *i* will harvest $\tilde{h}_i$ pounds of the total allowable catch under an ITQ system. Given a level of total allowable catch in a future year, τ, harvest will be:

$$\tilde{h}_i^\tau = EQ_i \cdot TAC^\tau$$

The single period gain in harvest over status quo management is[11]:

$$(3)\ G_i = EQ_i \cdot TAC - EC_i$$

[11] Note this gain is in terms of fish harvested. In terms of value, if trading is allowed, then Gi is the lower bound of this gain.

Equation 2 was used to calculate expected quota allocation until policy changed in a way that allowed for a harvester to drop low harvest years. In 1991, the council changed the initial allocation of halibut quota so that halibut harvesters could drop the two lowest performing years and sablefish fishers the single lowest. The harvester's expected value (income) under status quo vs. ITQ management depends on the individual's expected future landings (weight and value). The probability a harvester opposes rationalization is increasing in the difference between their private value of expected future landings and historic average catch.[12]

There are many reasons an individual's private valuation of future landings may exceed actual average catch. Public comments indicate that individuals with higher volatility in catch and those not present in the fishery for all qualifying years oppose rationalization. These harvesters may optimistically view historic catch by making excuses for low harvest years and believing good years more accurately represent skill. It is also anecdotally the case that individuals with higher volatility in catch claim to have had a shorter history of participation and believe they have yet to reach potential, i.e. learning is possible. This is consistent with economic theory. If a high year of catch is used to form the expected future catch, whether this belief is rational or not, for instance $EC_i = \max {h_i}^t$, then the difference between this value and the allocated share will be greater for high volatility harvesters.

Fishers expected to have high volatility in annual landings include: those with missed years, new entrants to the fishery, and those with less dependable skill or negative productivity shocks resulting in inconsistent catch from year-to-year. These high volatility

[12] Even if TAC or price changes under different management regimes, the likelihood of opposition is still increasing in this difference.

fishers are expected to gain less or lose from ITQs, and hence have increased likelihood of opposing ITQs. These arguments lead to three testable predictions:

Prediction 4a: Vessel owners with greater difference in expected quota allocation and actual average landings are more likely to oppose ITQs.

Prediction 4b: Vessel owners with higher annual variation in landings are more likely to oppose ITQs.

Prediction 4c: Vessel owners with shorter history of participation in the fishery are more likely to oppose ITQs.

New vessel owners can be expected to have higher volatility in landings due to low number of years of landings and inexperience. As outlined in prediction 4a and 4b, higher volatility results in higher levels of opposition. In fisheries distributing initial quota shares by grandfathering, harvesters who spent years not fishing, or just learning about the fishery, will rationally expect their future landings to increase. Prediction 4c is supported by Grainger and Costello (2014), who show analytically that new entrants are likely to oppose ITQs.

IV. Data and Empirical Design

Data

During the period from 1987 to 1992, individuals, companies, NGOs, and many other groups publically stated their position on ITQ adoption by written or oral communications. I coded these state positions from actual transcripts and written communications, and then linked to the vessel registry. The final data set consists of observations from 900 vessel owners that own a total of 1,212 vessels. The vessel owners are further broken down into

groups by species harvested—5 32 harvest only halibut, 55 harvest only sablefish, and 306 harvest both species.

I define an observation as a public comment recorded at a Council meeting or a letter addressed to council regarding IFQ implementation. The entire dataset consists of 3,210 comments made by 2,904 unique individuals via meeting participation or letter writing between the years of 1987 and 1992. I code participation records according to stated position on ITQs, and records that are ambiguous are dropped from the sample. Of the original 3884 participation records, 674 are dropped because the stated position on ITQs is uncertain, undetermined, or unaddressed by the record. The primary focus of this analysis is on a subsample (N=900) of the commenters that owned 1,012 vessels harvesting halibut, sablefish or both species during the qualifying period for initial quota allocation (1987-1990). My analysis utilizes a variety of data sources including NPFMC meeting minutes, NPFMC newsletters, and Alaska Federal Vessel Registry as described in Table 1. Column one provides the agency or source from which data was obtained. Column two provides a description of the types of data obtained from the source, and column three provides details on the actual data used in this analysis. The council keeps record of policy decisions, agenda items and public comment in "meeting binders" stored in Anchorage, Alaska. I visited the NPFMC office in Anchorage, Alaska and made copies of all meeting binder materials to build a data set of political participation.

To the best of my knowledge, the data described above represents the entire population of comments for the period 1987 to 1992. Up to 70% of individuals harvesting sablefish and 30% harvesting halibut between 1987 and 1992 made a public comment (written or oral) pertaining to ITQ implementation. An additional 2,310 individuals or companies not owning

vessels harvesting halibut or sablefish participated in the political process, either by mail or by speaking at a meeting. Although the overall number of sablefish harvesters is smaller, a much larger percentage of sablefish harvesters chose to participate in the political process.

Variables describing support or opposition and harvester characteristics are listed in Table 2. A comment is coded to determine demographic characteristics and the stance of the commenter on IFQ implementation. For most observations, the individual clearly states whether she is in favor of the proposal. For observations in which the individual's stance is not clear, the observation is coded as "uncertain." Each observation consists of a date, name, affiliation, occupation, location, vessel ownership status, and the comment/opinion expressed. Observations recorded from letters do not always contain affiliation of the individual(s), but consist of date of comment, name, and whether or not the individual is in favor of ITQs. A sample data letter is provided in the figures section of this paper (Figure 1).

Vessel owners in the state of Alaska are required to register their vessel in a vessel database. A unique file number identifies every individual or entity owning a vessel, and specific vessels owned are given a unique vessel number. When harvesters land fish in Alaska, they are required to fill out fish tickets, providing vessel and catch information including vessel number, date, and weight and value landed. To determine whether or not an individual owned a vessel, I searched the Alaskan State Vessel Registry for all participants by name, address and vessel name provided in the comment or letter. In this way the comment database is matched with the vessel registry database. If the individual owns one or more boats, all vessel information is recorded. This individual will typically have one unique file number with many vessel numbers. Other information provided by the vessel

registry includes vessel name, homeport, mailing address, ADFG (Alaska Department of Fish and Game) number, vessel length, gear, year, and ownership information.

Each vessel is assigned a unique vessel (ADFG) number, which is consistent over time. Upon making a landing, the vessel operator is required to fill out a fish ticket form containing information on the location, weight, value, date, and species landed. For the years the individual owns the vessel, the vessel's landings data are recorded from ADFG fish tickets. In this way, catch is matched to the vessel and then to the public comment.

An individual's catch and catch volatility is measured for each species (halibut and sablefish) for the four years 1987-1990, which are years for which catch data is available and for which actual quota allocation was to be based at the time letters were written. Annual standard deviation in catch and coefficient of variation (CV) are used as measures of harvester volatility. The coefficient of variation is equal to the standard deviation divided by total landings. CV is used in addition to standard deviation to control for increased magnitude of standard deviation as landings increase.

The participant's address (either return address, stated address, or address from vessel registry) is used to classify whether the individual is from a remote location. Remoteness is defined by whether or not the individual lives within driving distance of a town with a direct flight to Seattle. If the town of residence or homeport does not have direct air access to Seattle or is not within driving distance of such access, it is classified as remote (R_i=1). All towns with known location with airport access outside of Alaska are classified as non-remote (R_i=0). All observations with unknown locations are dropped from the analysis.

Empirical Design

The ideal experimental setting would randomly assign vessel ownership and annual catch, then individual position on ITQ management would be observed. Because this generating process is not observed, this paper does not directly establish causality; treatment of annual catch and vessel ownership is not exogenous. A concern in experimental design is that position on ITQs is endogenous to the characteristics of the individuals that determine catch. This is most concerning for individuals located in close proximity. Including a fixed effect for individual city helps to provide a strong argument for external validity.

The choice of participation is not exogenous to catch characteristics or position on ITQs. This paper is interested in actual participant position on ITQs- not the choice of whether or not to participate. I do not analyze what determines political participation. This analysis is performed in chapter two. Cost of participation in the political process is very low, and individuals with more extreme preferences are assumed to participate in the political process. Political participants accounted for 37% of total Alaska species landings value for the period of 1984-1991 and 12.75% of all sablefish and halibut harvesting vessels. Political opposition during the ITQ policy formation causes delays in implementation and changes to policy design. I address the question, amongst political participants, what determines opposition? In other words, external validity can only be assumed for individuals electing to participate in the political process.

The goal of this paper is to addresses whether explanations for opposition are consistent with observed behavior. Aspects of the design of the ITQ policy change through the formation process including the initial allocation formula, qualifying requirements, and selling/leasing rights. The design changes that occur are likely not exogenous of comments made previously.

An individual will be in favor of ITQs if she expects to be at least as well under the new policy setting. The position of party i, Y_i, on the implementation of ITQs is equal to one if in favor of ITQ implementation and zero if opposed. Y_i is regressed on the characteristics of party i that are expected to affect his or her position on ITQs using three different regression equations. All regressions are run using a linear probability model. A linear probability model allows the coefficients of the regressors to be interpreted as percentages and makes fewer distributional assumptions.

Regression equation (1) is performed on the entire sample of commenters and includes a dummy variable for vessel ownership, remoteness, and a dummy if the comment occurs in1992 or later, $L92_i$, when ITQ design changed. The dummy variable for vessel ownership, VO_i, is equal to one if the commenter is linked to a vessel ownership record during the study period. Equation (1) is used to test Predictions 1 and 2 by examining the coefficients on vessel ownership, VO_i and remoteness, R_i:

$$(1)\ Y_i = \alpha + \gamma R_i + \beta VO_i + \delta L92_i + u_i,$$

The subsample of commenters that own vessels is used to analyze the direct relationship between expected monetary benefits under ITQs and stated position on ITQs. All variables are specific to an individual or entity, denoted as subscript i. Variables specific to harvesters including Log Lbs, CV, SD, and percent participation, are specific to individuals and species, denoted as superscript F. Fish species F is equal to either S, sablefish, or H, halibut.

The anticipated change in distribution of wealth is mainly due to the redistribution of catch under ITQ management. The term D_i^F is the percent difference between the harvester's "participating average," the average when only including years fished, and the harvester's actual average when including all years. This term represents the disparity in expected quota

allocation and expected future catch under status quo management. Variables CV, SD, and Percent Years Participating are included in place of D_i^F in some specifications.

Regressions performed on vessel owners include a dummy variable indicating whether or not individual *i* is a sablefish harvester, S_i. This dummy variable S_i equals one if the individual harvests sablefish and zero otherwise. Regression equations two and three differ by whether they include the log of standard deviation in annual landings of individual *i* for species *F*.

$$(2)\ \ Y_i = \alpha + \gamma R_i + \theta S_i + \sum_F (\psi^F D_i^F) + u_i$$

$$(3)\ Y_i = \alpha + \gamma R_i + \theta S_i + \sum_F (\psi^F D_i^F + \Omega^F LogLbs_i^F) + u_i$$

Similar to specifications (1)-(4), prediction 2 is tested by examining the coefficient on remoteness, γ, and is expected to be negative—being from a remote location decreases the likelihood a vessel owner supports ITQs.

Prediction 3, that support for ITQs will be increasing in size of operation, is tested by including the coefficient on LogLbs, Ω, and is expected to be positive if higher landings contribute to increased probability of supporting ITQs. Including the variable LogLbs in the regression helps to isolate the effect of volatility on support by controlling for the size of operations (e.g. if larger operations inherently have higher standard deviation in annual catch).

Prediction 4a states vessel owners with greater difference in expected quota allocation and actual average landings are more likely to oppose ITQs. Prediction 4a is tested by

examining the coefficient on D_i^F in regression equation (3) which is expected to be negative if greater difference in expected quota allocation and actual average landings increases the likelihood of opposing ITQs.

Prediction 4b, vessel owners with higher annual variation in landings are more likely to oppose ITQs, is tested by substituting variables CV or SD in place of D_i^F. Coefficients on CV and SD are expected to be negative if higher variation in annual landings leads to increased likelihood of opposition. The CV variable is used in place of SD to control for correlation between size of operation and standard deviation in landings. Prediction 4c, regarding participation history support for ITQs by harvesters is tested by including the coefficient on Percent Years attending, and is expected to be negative if non-participation during the qualifying period decreases the likelihood of support.

V. Results

The descriptive statistics found in table 3 serve as prelude to results. Average landings for both species, measured in log pounds, are higher for individuals in favor of ITQs, which is consistent with prediction 2. Consistent with predictions 4a, 4b, and 4c vessel owners in favor of ITQs have a lower difference between expected catch and expected quota allocation; a lower average CV; and higher percent years participation than opposed vessel owners. While the conditional means appear to show vessel owners with standard deviation in landings are more likely to be in favor of ITQ, there is high correlation between pounds landed and standard deviation. This necessitates a statistical analysis to disentangle effects of variation in catch and size of operation.

Table 4 provides results for empirical specifications performed on the entire sample of commenters. Prediction 2 states that remote harvesters are more likely to oppose ITQs. I test

this prediction by including a dummy variable for remoteness in all specifications. The first four specifications are used for the entire sample to compare vessels owners to the entire population of commenters. In all four specifications vessel owner have a higher likelihood of support. In (2) and (3), remoteness is shown to reduce the probability overall that commenters are in favor, and (4) includes an interaction of remoteness with vessel ownership to test the sensitivity of vessel owners to being located in a remote location relative to other stakeholders. The magnitude on the coefficient on remoteness, -.303, can be interpreted as the non-vessel owner's change in base-line probability of ITQ support resulting from being located in remote location. The coefficient on vessel ownership, coincidently, offsets the effect of being remote entirely. Thus, remote vessel owners have a likelihood of opposition just of the interacted term (-.205). This result indicates vessel owners are sensitive to being located in a remote location, but that this effect is similar or less than that of non-vessel owning commenters. The remote variable is an important predictor of an individual's position on ITQs and is significant at the 1 percent level in all regressions in which it is included.

Table 5 provides results for empirical specifications (5-12) performed on vessel owners only. Prediction 3 states that opposition to ITQs will be decreasing in average quantity of fish landed. The effect of average landings on probability of supporting ITQs is tested by including the log of average pounds landed for each species in (5), (7), (8), (10), and (12). The coefficient on log of average pounds is consistently positive for both species and significant at the 1 or 5 percent level for sablefish. Increasing the log of average pounds landed by 1 percent, increases the probability an individual is in favor of ITQs by ~0.045 percentage points for sablefish and ~.01 percentage points for halibut.

The magnitude of the coefficient is small for small changes in average catch. However, given the high variance of average landings for both species, the effect may also be quite large. A 1% increase in average sablefish landings at the mean of sablefish harvest translates to harvesting an additional 61lbs of sablefish. However, the standard deviation of sablefish landings is 122,602lbs, meaning increasing average sablefish landings by one standard deviation results in a 90 percentage point increase in probability of supporting ITQs. The coefficient on the log of average halibut landings is only significant in (8), which includes standard deviation. The magnitude of the coefficient on halibut average landings is smaller than that of sablefish, with a maximum value of 0.0184, indicating a one percent increase in average halibut pounds harvested increases the probability of being in favor of ITQs by 0.018 percentage points.

Predictions 4A, 4B and 4C, relating to the expected change in landings distribution under ITQ management, are tested by examining coefficients on percent of years present in fishery in specifications (6) and (7), standard deviation of annual landings in (8), coefficient of variation (CV) landings in (9) and (10), and the difference in expected catch under quota system vs. status quo in (11) and (12). Log of average pounds is predicted to be an important determinant of position, prediction 3, but is excluded from (5), (8), and (10) to test the coefficients on the variables testing predictions 4A, 4B and 4C, with which it is highly correlated. When log of average pounds is combined with volatility variables, the explanatory power of the coefficients is weakened but the signs of the coefficients remain stable.

The coefficient on percent of years present in fishery is expected to have a positive effect on the probability of being in favor of ITQs, but all other coefficients are expected to be

negative. The coefficient on percent years in attendance is used to directly test prediction 4c*:* vessel owners with shorter history of participation in the fishery are more likely to oppose ITQs. The sign of the coefficient on total years is consistently positive, but the magnitude is quite small for both species. An increase of one percent in the percent of years in attendance increases the probability of being in favor of ITQs by around 1 percentage point in specification (7). The coefficient on percent years participating is only statistically significant for Sablefish in (6) at the 10 percent level.

The coefficients on CV and SD are used to test prediction 4b: vessel owners with higher annual variation in landings are more likely to oppose ITQs. The coefficient on both halibut and sablefish SD is insignificant for both specifications used, and the sign on the sablefish SD deviates from predictions. These estimates are imprecise because standard deviation is highly collinear with total catch. Larger boats tend to be in favor of ITQs, but also have, on average, higher standard deviation. The coefficient of variation is used as an alternative measure to SD of harvester volatility over time. The CV, provides a control for the high degree of correlation between average landings and standard deviation. Unlike the coefficient on SD, the coefficient on CV is consistently negative for both species in all specifications, and is significant at the 5% level for sablefish in (9).

VI. Conclusion

This paper analyzes the role of distributional concerns in determining a harvester's preference for the Alaskan sablefish and halibut ITQ program. It provides strong evidence that the allocation of quota share helps explain the stated preference, for or against, of a stakeholder or vessel owner. Using a unique data set of individual comments on ITQ adoption, catch history and vessel ownership, I find political support for ITQs to be higher

amongst vessel owners, agents located in non-remote locations, high volume fishers and low volatility fishers. These results are consistent with theoretical predictions and are the first empirical results on the factors that lead to opposition to rights based management in fisheries.

The Alaskan halibut and sablefish ITQ program, as initially proposed, did not account for individual production shocks or inconsistent fishing in determining initial quota allocation. The original program was never implemented. After five years of public debate, the final version of the ITQ policy was designed in such a way that increased the distribution to small fishermen, new participants, and fishermen incurring negative productivity shocks. This was accomplished by dropping the lowest performing years when calculating quota shares. Ultimately, the initial grandfathering of quota for sablefish was calculated using the best five of six harvest years for 1985 through 1990, and the best five out of seven years, 1984 through 1990, for halibut (NPFMC, 1997).

The adoption of property rights hinges on the acceptance of resource users and other stakeholders. These parties receive benefits under status quo management, and can oppose changes using the political process. The intended permanence of the rights and the fact that trading of rights can provide windfall gains provides stakeholders with incentive to jockey for position in the initial allocation process. This paper provides insight into the political economy of transitioning out of inefficient resource management and its findings echo Hanneson (2004): "those who expect to gain, will promote and support the new institution, those who expect to lose will fight it with equal or greater vigor."

Much of the existing economic literature focuses on policies that achieve economic efficiency and sustainability goals. However, the role of distribution in the implementation

of new policy is less frequently addressed. To achieve political feasibility, trade-offs between addressing distributional concerns and economic efficiency are often required. The tradable aspect of individual quotas allows the resource to be continuously reallocated to its highest valued uses, but rights are rarely fully tradable in fishery property rights programs. Like many cap-and-trade and property rights based management programs, fishing rights deviate from traditional economic models by including provisions to limit distributional impacts. Two major policy design aspects altered to address political concerns in the formation of the halibut and sablefish ITQs are ownership restrictions (concentration caps) and changes to the initial quota allocation formula. Support for the ITQ program significantly increased with the grandfathering allocation formula changed to be more flexible.

When distributional concerns generate political opposition, policy makers may look to reformulating the way quota is initially allocated to achieve political feasibility. The initial allocation of rights should be independent of achieving economic efficiency (Coase, 1960). Providing "forgiving years" can help achieve political feasibility without sacrificing the cost savings provided by fully transferable aspect of quotas. Utilizing grandfathering rules as a method of addressing distributional issues under the new property rights regime may allow policymakers to design politically feasible management systems without sacrificing efficiency.

VII. Sources

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VIII. Table and Figures

Tables

Table 1: Data Sources (Years 1987-1992)

Source	Description	Details	Managing Agency
NPFMC Meeting Minutes	Minutes of council meetings covering agenda items (proposed changes to management).	Name, location, agency, comment, date	NPFMC
NPFMC Newsletters	Quarterly newsletter to inform public of changes to FMPS and agenda items for upcoming meetings. Includes upcoming events, forums, and fishery news.	Proposed/Implemented changes to FMP	NPFMC
ADFG Fish Tickets	Log of all landings made in the state of Alaska.	ADFG number, species landed, weight, value, port, year and month of landings	ADFG
Alaska State Vessel Registry	Listings of vessels licensed by the state of Alaska to participate in commercial fishing activities.	ADFG number, ownership information (name, address, phone), vessel characteristics, years of ownership, home-port	CFEC

Table 2: Variables Description

Variable	Description	Calculation	Source
Sablefish	Dummy variable for whether or not entity harvests sablefish between 1987 and 1990.	Sablefish=1 if total weight landed between 1987 and 1990>0; =0 otherwise	CFEC Fish Ticket Data; AK Vessel Registry
Remote	Dummy variable for whether or not entity's mailing address is located in a remote community.	Remote=1 if city of residence is classified as remote (1); =0 otherwise	Based on criteria described in text
CV	Variable measuring coefficient of variation in catch for each species at date of comment.	=SD Annual Landings/ Average Landed Weight	CFEC Fish Ticket Data
Log Lbs.	Measure of the log of the average landed weight by species at date of comment.	= LOG(Average Lbs.)	CFEC Fish Ticket Data
SD	Measure of the standard deviation in annual landings for each species at date of comment.	= Standard Deviation in Annual Landings	CFEC Fish Ticket Data
Percent Years Participating	Measure of the percent of years present in each fishery (harvest>0) at the date of comment.	=Participating years/Total Years	CFEC Fish Ticket Data; AK Vessel Registry
D	Measure of the difference between "participating average," the average when only including years fished, and the harvester's actual average when including all years	=(Participating Average-Actual Average)/Participating Average	CFEC Fish Ticket Data; AK Vessel Registry

Table 3: Summary Statistics

	Sablefish		Halibut	
Variable	Opposed	In favor	Opposed	In favor
Log Average Pounds	9.48	11.18	9.24	10.18
Standard Deviation (SD)	56,094.32	127,334.70	16,972.31	25,967.58
Coefficient of Variation (CV)	2.11	1.78	1.85	1.55
Percent Difference Quota	69.61%	61.09%	61.26%	51.91%
Percent Years Participating	30.51%	39.11%	39.05%	48.78%
Remote	76.47%	32.18%	85.29%	34.26%

Table 4: All-Population Regressions

	(1)	(2)	(3)	(4)
Variable		Position (1=support)		
Remote		-0.362***	-0.364***	-0.303***
		-0.0711	-0.0702	-0.0654
Vessel Owner	0.156**	0.154*	0.157**	0.303***
	-0.0783	-0.0803	-0.0794	-0.0646
Remote x Vessel Owner				-0.205**
				-0.095
Letter Year>1991			0.0455*	0.0417
			-0.0274	-0.0273
Constant	0.113	0.373***	0.360***	0.318***
	-0.069	-0.0625	-0.0603	-0.0602
Observations	3,071	3,071	3,071	3,071
R-squared	0.038	0.236	0.239	0.252

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Vessel Owner Regressions

	(5)	(6)	(7)	(8)
Variables		Position (1=support)		
Log Lbs: Sablefish	0.0462***		0.0451**	0.0502***
	-0.0173		-0.0179	-0.0175
Log Lbs: Halibut	0.00971		0.00673	0.0165***
	-0.00846		-0.00868	-0.00595
% Years Present: Sablefish		0.260*	0.0441	
		-0.137	-0.124	
% Years Present: Halibut		0.0358	0.0619	
		-0.0455	-0.0505	
SD: Sablefish				1.39E-08
				-7.06E-08
SD: Halibut				-1.41E-06
				-8.75E-07
Remote	-0.397***	-0.430***	-0.398***	-0.393***
	-0.112	-0.106	-0.111	-0.106
Sablefish	-0.211*	0.161*	-0.221*	-0.231*
	-0.123	-0.0882	-0.125	-0.132
Letter Year>1991	0.102***	0.0968**	0.0999***	0.0945**
	-0.0349	-0.0373	-0.0362	-0.0363
Constant	0.335**	0.436***	0.341**	0.291***
	-0.135	-0.0829	-0.135	-0.11
Observations	900	900	900	900
R-squared	0.381	0.359	0.383	0.384

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Vessel Owner Regressions

Variables	(9)	(10)	(11)	(12)
Log Lbs: Sablefish		0.0407**		0.0438**
		-0.0182		-0.0175
Log Lbs: Halibut		0.0112		0.0113
		-0.0107		-0.0106
CV: Sablefish	-0.122**	-0.0455		
	-0.049	-0.0553		
CV: Halibut	-0.00984	-0.0283		
	-0.0157	-0.0231		
% Difference Quota: Sablefish			-0.297**	-0.0504
			-0.134	-0.141
% Difference Quota: Halibut			-0.00307	-0.0677
			-0.0399	-0.0591
Remote	-0.420***	-0.396***	-0.427***	-0.399***
	-0.105	-0.11	-0.107	-0.111
Sablefish	0.489***	-0.0838	0.449***	-0.17
	-0.132	-0.211	-0.141	-0.177
Letter Year>1991	0.0970**	0.103***	0.0979***	0.103***
	-0.0374	-0.037	-0.0369	-0.0362
Constant	0.459***	0.375***	0.448***	0.366***
	-0.0883	-0.126	-0.0901	-0.129
Observations	900	900	900	900
R-squared	0.364	0.385	0.359	0.383

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figures

Figure 1: Example Letter

AGENDA C-4
JUNE 1990
SUPPLEMENTAL

I-114

RECEIVED
JUN 23 1990

June 19, 1990

Mr. Don Collinsworth, Chairman
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
P. O. Box 103136
Anchorage, Alaska 99510

Dear Chairman Collinsworth:

I would like to go on record as being actively opposed to the implementation of an individual fishing quota system for sablefish in Alaska.

The system as proposed would be detrimental to the coastal communities and to the fishing industry. I believe that if the IFQ plan were to be approved by the Council, that the entire nature of the fishery would change and the losers would be Alaskans.

I urge you not to approve the proposed IFQ method for management of our sablefish fishery.

Sincerely,

KODIAK FISHERMAN
MARC [redacted]
[redacted] KODIAK, AK
99615

[redacted]

Chapter II

The Decision to Participate: The Role of Influence and Cost in Stakeholder Participation in the Formation of the Public Policy

The Case of the Alaskan Sablefish and Halibut ITQs

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Public policy is often made after the opinions of interested parties are solicited. Often, an individual, firm, or other organization can participate in the political process through voting, contributing to campaigns, lobbying, attending public meetings, or letter-writing. The timing and ultimate outcome of policymaking is shaped by this participation, but there is limited empirical evidence that examines how cost and expected gain from participation affect the decision to participate. We analyze political participation in the formation of the Alaskan halibut and sablefish individual fishing quotas. The data set provides income and demographic details of political participants and non-participants. The process in which fisheries policy is implemented allows for individuals to participate at different cost levels ranging from nearly zero to thousands of dollars. We provide a broad literature review of political participation and describe the process of participating in United States fisheries

management. We then examine current theories of political participation in the context on the case at hand.

I. Introduction

The difficulties of transitioning out of an inefficient management regime are linked to the cost of the process by which a new institution is created and adopted (Libecap 1989; 1993). Political resistance to new institutions can result in delays or even stop the policy formation and adoption process. In the transition from one resource management regime to another, some users may see net costs even if the overall gains are large. Understanding the motivations for participation helps in the formulation of a positive theory of the policy formation process and its outcomes. The decision of a stakeholder to voice his or her position on a policy issue has been addressed most thoroughly in voter turnout literature. However, the ability to understand the determinants of participation when it is limited to a single act per issue is limited. Of importance to this paper, empirical analysis of voting typically fails to allow the researcher to differentiate between expected utility changes and the cost as determinants of participation.

This paper examines the determinants of political participation in the context of fisheries regulatory reform where stakeholders can choose to participate in several modes and potentially influence outcomes. We provide a unique contribution to the political participation literature by using individual level data to compare characteristics of agents participating in the political process at different cost levels. This is accomplished by using a sample in which stakeholders may participate for free, not participate, or physically

participate in the political process by attending a meeting. Stakeholders that do not attend meetings may chose not to attend because of the high cost of travel and time, a low perception in their probability of influencing the outcome, or a small difference in expected utility under different policy outcomes. Data on participation in five different rounds of public discussion around the establishment of Alaska's halibut and sablefish individual transferable quota (ITQ) program is combined with detailed characteristics and performance of participant and non-participant stakeholders to study the determinants and mechanisms of participation in the political process. The rich data on allows us to construct variables that are directly linked to the expected benefits of the ITQ regime such as the difference in expected catch under the two regimes. Other variables, such as distance from the public hearing location, can be used as a source of variation in cost for some, but not all, modes of participation.

The purpose of this paper is twofold. First, to survey the general literature on political participation in order to identify the main hypotheses in the literature that explain participation in political process, and to summarize the available empirical evidence. Second, to conduct basic analysis of the data on Alaska's fisheries that can provide a broad picture of the likely determinants of participation behavior. The paper is structured as follows: Section I provides a review of relevant political participation literature. Section II provides the institutional specifics of fisheries management in the United States and describes the policy implementation process of the IFQ. Section III describes the participation data in the halibut and sablefish ITQ programs, and IV conducts basic data analysis to understand participation by taking advantage of the rich detail and variation in the Alaska fisheries data. A discussion follows.

I. Background

This section reviews literature relevant to political participation, specifically in the context of voting, as well as less conventional modes of participation such as petition signing. The decision to participate in the political process, particularly the electoral process, has been studied extensively by political economists. Most of the political participation literature focuses on voter turn-out. The key conclusions from this literature are summarized, and the extent to which they can be applied to less common forms of political participation such as writing a letter, signing a petition or attending a meeting is discussed.

Participation Models

In the political science literature, political participation is categorized as either *conventional* (formal) or *non-conventional* (nontraditional) (Milbrath, 1965; McFarland and Thomas, 1996; Goldstone, 2003; Heaney and Rohas, 2006). Some examples of formal participation include electoral participation, lobbying, attending a meeting, and contacting elected representatives. Non-conventional forms of participation such as protests, demonstrations, or petitions have become increasingly popular relative to electoral participation, and discussions of these forms of participation have increased in the literature (Dalton, 2008; Klingemann and Fuchs, 1995; Norris et al., 2005; Finkel and Opp, 1991; Putnam, 2000; Schussman and Soule, 2005)[13]. Generally, political participation is modeled as being undertaken when an individual or group has preferences about policy outcomes or candidates. The voter turnout literature analyzes the effect of individual traits and social characteristics that influence political participation. Individual characteristics influencing participation include: cost of participation, access to information, socioeconomic status,

[13] See figure 2 in appendix (from Dalton, 2008). Trends in American Political Participation.

civic knowledge and political efficacy. Social factors also affect the decision to participate, with voter turnout found to increase significantly with group identity (Schram and Sonnemans, 1996).

Some of this work has an economic underpinning. The seminal work by Downs (1957) summarizes a rational agent as a person with transitive preferences who always chooses the highest rated of his preferences and makes consistent decisions through time. The rational choice model was one of the earliest models of political participation, and asserts thatrational individuals participate in political activity when the benefits of such activity outweigh the costs (Aldrich, 1993; Riker and Ordeshook, 1968). One of the predominant views on the decision to participate assumes people engage in a strategic cost benefit calculation of participation. Participation occurs when the probability an individual influences the outcome π multiplied by the expected benefits, B, exceeds the costs of participation, C. Participation Y is a binary variable equal to one if an individual participates. That is:

$$Y = \begin{cases} 1 & if \quad \pi B - C \ \geq 0 \\ 0 & otherwise \end{cases}$$

The benefits variable B, is defined as an individual's expected benefits if the ideal policy or politician is selected. In the context of national elections, the probability any individual's vote is pivotal is near zero, making the act of voting a paradox at even extremely small costs of participation (Olsen, 1965). To account for participation at very low probabilities, traditional models have been modified to include the consumption benefit of voting, V (Riker and Ordeshook, 1968).

$$Y = \begin{cases} 1 & if \quad \pi B - C + V \ \geq 0 \\ 0 & otherwise \end{cases}$$

An individual's sense of civic duty, social pressure, and warm glow may contribute to benefits exogenous to the outcome, V. Voter turnout is decreasing in the cost of voting (Wolfinger and Rosenstone, 1980; Powell, 1986; Riker and Ordeshook, 1968). Some examples include: distance to the polling place, weather, registration requirements, and time required to think about the voting decision (Feddersen, 2004). The costs of participating by attending a public meeting or hearing is analogous to those of voting; participants spend time gathering information, preparing submissions, and travelling to hearings (Osborne et al, 1999). In the 1988 presidential election, one inch of rain was estimated to reduce turnout by about 8% (Shachar and Nebluff, 1999).

A variation of the rational choice model, the group rule-utilitarian model, assumes elections naturally split potential voters in to one of two groups: supporters or opposers (Coate, Conlin, and Moro, 2007). Members of each group chose a voting rule that, if followed by everyone else in the group, would maximize their side's aggregate utility. Each group creates a participation rule that specifies the critical cost level below which a group member should participate. These "equilibrium voting rules" depend on the relative sizes of the two groups, election-specific characteristics and expected cost of voting. In the context of smaller, local meetings, these group voting rules imply participation, which is coupled with coordination with other voters, may be more influential.

Political economists most commonly use resource models[14], where political participation is dependent on individual resources such as money, time, and civic skills. The

[14]Resource models are referred to as the Civic Voluntarism models and SES models.

first resource models of political participation specified two prime resources in determining political participation: money and time. Time is a resource that an individual can contribute to the political process by working in a campaign, writing a letter to a public official, attending a community meeting (Brady et al., 1995), or gathering information. Matsusaka (1995) argues that the probability of turning out increases with the individual's information level. This model is a departure from the rational-choice models, suggesting the probability of participation in the political process is a preference based on individual characteristics, rather than their stake in the outcome.

Similarly, the socioeconomic status (SES) model of political participation asserts individuals with higher education, higher income, and higher status jobs are more active in politics. According to Pattie et al. (2004), individuals with the greatest access to resources, the rich and well-educated, dominate political engagement. Tying this to rational choice models, SES may influence participation through enhancing the efficacy of any action. Game theoretic models of Feddersen and Pesendorfer (1996, 1999) suggest higher income individuals with higher education have access to higher quality information about political issues, and should therefore vote in greater number. Larcinese (1999) argues that wealthier individuals have a greater incentive to be more informed, since the benefit of policy-relevant information increases with income. Uncertainty increases an individual's expected regret from political participation by increasing the probability she selects the "wrong" candidate. Degan and Merlo (2004) suggest this implies a positive relation between information and turnout. The positive effect of education on participation has been demonstrated empirically, for both traditional and non-traditional forms of participation (Marien, 2010).

A third theory of political participation, the mobilization model, states individual

level participation is determined by political opportunities in the voter's environment and outside social pressures. The mobilization model is linked to the resource model through political opportunities. Individuals with greater resources are more likely to have access to institutions facilitating political involvement. These sorts of institutions are less commonly found in communities where low-SES individuals live (Verba, Schlozman and Brady 1995: 337–43). Support for the mobilization model has been established by examining turnout in elections as a function of campaigning. While these models attribute participation are not entirely based on economic logic, they do provide an explanation for why people act, and especially to vote, when a purely rational model suggests they would not.

Influence

A key aspect of many models of participation is the degree to which an individual believes their participation will be influential. Even if participation is costless, an agent believing participation is worthless will likely abstain. Low levels of political efficacy are associated with a failure to participate (Schlozman, Verba, and Brady 2012; Verba, Schlozman, and Brady 1995; Whiteley 1995). If the agent's participation results in a change in value of the outcome greater than the cost of participation, the agent will participate. Because these models are typically about voting, the level of influence is related to the number of participants, with influence decreasing with population. Bias (2000) finds electoral participation to be decreasing in the size of the voting base and increasing in the election's closeness. Osborne, Rosenthal, and Turner (1999) study participation in a collective decision-making process and find participation falls with population size. Discussion of what makes participation more or less influential for other types of participation is more closely associated with literature on lobbying and influence in politics.

Influence may also explain the act of not participating. In 1975, Verba, Schlozman, and Brady suggested that one helpful way to understand participation is to ask why people do not participate politically. The authors provide three explanations for abstention: "because they can't; because they don't want to; or because nobody asked. In other words people may be inactive because they lack resources, because they lack psychological engagement with politics, or because they are outside of the recruitment networks that bring people into politics. (Verba, Schlozman, and Brady 1995: 269)"

Earlier papers by economists Osborne, Rosenthal and Turner (2000) and Feddersen (1992) view an outcome or policy as a point in space. In such spatial models, an agent's utility is maximized at a single consumption bundle and utility is decreasing as the policy moves further away in the policy space. Like other models of participation, an individual's decision to participate depends on her perceived level of influence over policy outcomes and the cost of participation. Both Feddersen (1992) and Osborne et al. (2000) predict participation to be lower for agents whose ideal policy outcome is close to the anticipated outcome (Osborne et al., 2000). Osborne 1999 et al. find participation decreases as preferences over the policy space become more moderate. In a situation when voting is costless, Feddersen and Pesendorfer (1996) find agents with no strong preference for one outcome versus the other abstain. Empirical findings indicate firms with preferences for extreme policies are more likely to participate in public meetings determining regulation (Bulkley et al., 2001; Turner and Weninger, 2001).

Self-Interest

There is strong empirical analysis that political participation is a function of policy consequences at the individual level. Evidence of self-interest motivated participation has

been found in many political settings: social security reform, student loans, school board elections, and affordable housing reform. Individual level analysis reveals that political participation is higher when the stakes are higher. In a study of political participation by seniors in social security policy formation, participation was highest for seniors that were more dependent on social security benefits and less common among higher-income seniors (Campbell, 2002). This result was especially pronounced for letter writing about the program. Ozymy (2012) analyzes student borrower's participation in political activities related to student loans (voting, contributing, and contacting officials), and finds the probability of participating increases as their income decreases.

Empirical findings suggest that participation in program and policy formation is also motivated by self-interest. Shavit, Lahav, and Shahrabani (2014) examine the role of self-interest in the decision to take an active part in the context of political protests. In 2011, hundreds of thousands of Israelis protested the rising in the cost of living. The authors distributed questionnaires to MBA students asking whether the person engaged in protest activity and other details influencing participation. One of the major findings is that more active participants tend to rent homes. The authors suggest a renter's incentive to protest is high because they expect their action would influence government to take actions to make housing more affordable for people like them. These empirical studies suggest rational choice models can provide important insight into participation, but that SES models also provide important additional insight. Hastings et al. (2007) examine the effect of school lottery outcomes on voting behavior in a school board election. Overall, losing the lottery was found to have no significant impact on voting behavior in a school board election.

When restricting the sample to likely voters[15], lottery losers with above median income and prior voting history were significantly more likely to vote than lottery winners.

Empirical analysis of political participation at the election level is abundant, but analysis of participation through less conventional channels such as public meetings is limited. In the context of fishery council meetings, Turner and Weninger (2005) find that participation in council meetings is higher for larger, closer, and more influential firms. Lise (2000) uses household survey data to examine determinants of voluntary participation in India's forest management. Household participation in forest management is found to be increasing in their dependence on forest goods such as fuelwood and timber. Social and economic factors are also important determinants of participation. In a similar case study in Haiti (Dolisca et al., 2006), high forest dependency stimulates participation in forest management. In the context of public meetings determining waste management decisions, McComas (2001) finds that meeting attendees tend to report higher incomes and have at least one child living at home, and in one of the two communities studied, individuals that previously attended meetings tended to perceive greater risks from the waste site. All of these studies suggest individual self-interest plays a large role in the decision to politically participate. The literature is tied to the case of fishery management in the following section, but first background on the context of the case is provided.

II. Institutional Setting

I now describe the policy setting in which United States fisheries policy is implemented, and how individuals participate. The policy formation of ITQs in the Alaska

[15] White or high-income families

halibut and sablefish fisheries was an iterative process influenced by political participation. The policy design changed a number of times through the seven years of deliberations. Changes in policy-changed fishers expected benefits under the new regime, and consequently incentives for political participation. We are able to construct measure of changes in individual level-benefits during different stages of the ITQ policy formation. Based on findings of previous political participation literature, political participation in fisheries management is expected to depend on self-interest, influence, and cost of participation. The size of the constituency for fisheries policy is smaller than that of the US electorate, so the literature on influence would suggest that perceived influence is higher in this context. Literature on self-interest and participation would suggest individuals standing to gain or lose the most under the new ITQ policy would have higher incentive to participate. The constituency of the policy makers of Alaskan fisheries is relatively small, but the geographic distribution is large. Vessel owners fishing in Alaskan waters have a large degree of variation in distance to meeting, and hence cost of attending a meeting. We exploit variation in distance to examine the role of costs in attending fishery council meetings.

The North Pacific Fishery Management Council (NPFMC)

In United States, fishery management decisions are made by regional councils operating under the authority of the Magnuson-Stevens Act (MSA, 1976). The MSA (1976) extended US control to waters up to 200 miles off the coast, known as the EEZ and established measures to prevent overfishing. The North Pacific Fishery Management Council (NPFMC) governs waters off the coast of Alaska. The regional fishery management council prepares, implements and amends fishery management regulations and plans for

fisheries occurring inside of the EEZ. When reviewing potential rule changes, the Council draws upon public input and the services of advisory bodies consisting of experts from state and federal agencies, universities, and the public, who serve on panels and committees. The NPFMC consists of eleven voting members—all political appointees. Seven council members are private citizens from Alaska and Washington and are appointed by the Secretary of Commerce based on recommendations of the governors of the states. The private citizen council members are familiar with marine biology, the fishing industry, and/or marine conservation. The council also includes four non-voting members representing the Pacific States Marine Fisheries Commission, the U.S. Fish and Wildlife Service, the U.S. Department of State, and the Coast Guard. The council composition is designed so that all stakeholders are represented. Council meetings are open to public comments—written, emailed and oral.

All council decisions are made by recorded vote in a public forum after public input. Council decisions are then subject to further public input when reviewed by the National Marine Fisheries Service (NMFS). The final decision is sent for a second review to the Secretary of Commerce, who receives further public comment, and final decisions are made. If a stakeholder opposes a proposed change in management or "amendment" to a fishery management plan, these concerns can be expressed in the public forums of council meetings or NMFS meetings. Public input and distributional concerns are taken into account in all stages of policy formation and review. Members of the fishing industry and the general public may participate in the policy formation in a variety of ways including testifying at council meetings or letter writing. The extent to which stakeholder participation influences

management design and implementation depends on their political clout, which is related to financial resources, political connections, and ability to mobilize public support.

All council decisions are subject to intense regulatory review and must conform to a variety of regulatory acts and laws[16]. The timeline for regulatory change can take over a year, with duration increasing if the regulation is complex or contentious. In the context of US fisheries, decisions about resource management are mandated by the Administrative Procedure Act to incorporate stakeholder input (Turner et al, 2005).[17] It is apparent that political opposition has halted or delayed many resource management programs in the United States. When Congress reauthorized the primary law governing fisheries management in US federal waters, the Magnuson-Stevens Act (MSA, 1976) in 1996, political pressure from the processing industry and other equity concerns led to the issuance of a 6-year moratorium on the creation of new ITQ programs (Guide to U.S. Environmental Policy). Prior to the MSA reauthorization, Alaskan Pollock harvesters attempted to strengthen the institutions governing the fishery, but political protests from processors halted any new or pending plans to change management regimes in a way that allocated rights to individual harvesters.

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[16] Magnuson-Stevens Act, Endangered Species Act, Marine Mammal Protection Act, Regulatory Flexibility Act, the National Environmental Policy Act, executive orders and other applicable law

[17] The Administrative Procedure Act requires that all U.S. federal regulatory agencies "shall give interested persons an opportunity to participate in the rulemaking through submission of written data, views, or arguments with or without the opportunity for oral presentation" (Title 5 U.S. Code Section 553(c), 1988 edition). In Corrosion Proof Fittings v. Environmental Protection Agency (1991) the Supreme Court showed its willingness to require that public opinion be adequately consulted. (In this case, the court vacated proposed regulation because the Environmental Protection Agency prematurely ended public hearings and deprived the public of sufficient opportunity to "comment [on], analyse, and influence the [regulatory] proceedings"

Development of the Halibut and Sablefish ITQ program

In 1987, the NPFMC publically announced its decision to consider ITQs as a policy action to solve the problems associated with the derby fishing of both sablefish and halibut. Due to disputes over allocation, concerns for small fishing communities, and other program characteristics, the ITQ program was not officially adopted until 1995. Political participation played a major role in the time-line and shape of the final ITQ program. A timeline of major events in the development of the ITQ program was constructed using NPFMC newsletters is shown in Table 1.[18]

Individuals have a variety of avenues to participate in fisheries policy formation. The types of participation vary in cost, and potential benefits. We classify observations in to one of three levels of participation. The least costly form of participation is signing a petition, which takes very little effort and cost is assumed to be negligible. The second level of participation is contacting a legislature. An individual may contact a policy maker by writing a letter, sending a telegram, or phoning in. Participation by contacting a policy maker requires more effort and potentially more resources than signing a petition. The third and most intense mode of participation is speaking at a fishery council meeting. Council meetings are only held 4-5 times per year and travel is costly in terms of money and time, especially given the limited transportation infrastructure within the state of Alaska.

Participation levels in the ITQ policy formation varied over the formation process. Different levels of participation are expected to be a result of changes in individual expected benefits through the different changes in policy design. The increasing probability of ITQ

[18] The NPFMC releases five newsletters annually after council meetings.

implementation also likely increased participation over time. This is in line with previous literature finding the closeness of elections increases voter turnout. Participation is also expected to be decreasing in cost and increasing in influence. The extent to which an individual will benefit by participating in the political process of reform depends on the cost of participation, the individual's perceived influence over the political process, and the difference in welfare under the two different management regimes.

Self-interest

The bargaining position taken by individuals is determined by their expected welfare under new management vs. status quo. The most obvious determinant of change in welfare under ITQs is an individual's participation history in the fishery. The initial quota allocation determines the distribution of wealth and decision making power over the resource. Quota is typically allocated via grandfathering, which allocates harvesters a percentage of the total allowable catch based on historic average catch for a given time period. Every time the policy design changes in a way that changes an individual's expected benefits under new management, incentives to participate will change. Incentives to participate in the policy formation process change as the policy changes. We construct variables to measure individual's expected change in benefits at different stages of the policy formation process.

Influence

Participation also depends on the extent to which an individual believes her participation will influence the policy outcome. There is evidence that larger firms are more influential, and therefore receive greater benefits than smaller firms by attending a meeting. Attending a meeting is also the most visible form of participation, and is expected to be the most influential in political decision making.

Cost

Vessel owners participate in the policy formation process by written communication or attending a meeting. The cost of attending a meeting varies by vessel owner, and depends on cost of transportation and time. In general, the further a vessel owner's city of residence is from the meeting location[19], the greater the cost of travel to the meeting. An individual will attend a meeting if expected benefits of attending outweigh the costs. As distance from the meeting increases, so does time and travel cost of attending. Signing a petition is the least costly form of participation. Both letter writing and signing a petition are expected to be more popular modes of participation than attending a meeting.

III. Data

Data used in this paper is derived from three sources: public communications regarding Alaska fisheries ITQs; Alaskan State Vessel Registry; and Alaska Fish tickets. Public communications are either written testimony or oral testimony. Written testimony refers to letters, petitions, form letters, or resolutions addressed to either the NPFMC or other governmental officials regarding fishery ITQs. During the period from 1987 to 1991, individuals, companies, NGOs, and many other groups publically stated their position on ITQ adoption by written or oral communications. Oral public comments are made at council meetings or "scoping meetings" in which fishery ITQs are discussed. For the study period, public meetings are held four to five times annually. All public communications are coded to record the name, address, occupation, company or organization of the agent participating.

[19] Council meetings are typically held in Anchorage, Alaska.

The stance of the participant on ITQ reform is also recorded. A sample data letter is provided in the figures section of this paper (Figure 1).

The stated positions have been coded from actual transcripts and written communications, and then linked to the Alaskan Vessel Registry. If the individual is determined to own a vessel, the unique vessel number (ADFG number) is recorded. Vessel owners in the state of Alaska are required to register their vessel in a vessel database. A unique file number identifies every individual or entity owning a vessel, and specific vessels owned are given a unique vessel number. When harvesters land fish in Alaska, they are required to fill out fish tickets, providing vessel and catch information including vessel number, date, weight and value of landings. Linking individual participation to the vessel registry and fishery participation data enables us to track the harvest, revenue and city of residence of all vessel owners that participate in the political process versus those that do not.

The political participation database consists of participation records from years 1982-1995. I restrict my discussion to vessel owners during the ITQ formation process (1987-1991). The data set consists of 835 unique vessel owner observations that own a total of 1,155 vessels between participating in the sablefish or halibut fisheries. An observation is defined as a vessel owner's political participation status each round. The entire dataset of participants consists of 3,872 comments made by 2,903 unique individuals via meeting participation or letter writing between the years of 1987 and 1991. Participation records are coded according to stated position on ITQs. Most comments are very explicit in their policy preference, and are coded as either in favor or opposed. Observations are coded as uncertain, U, if the comment is an inquiry in to ITQ design or if the comment is making suggestions. If

the observation does not pertain to ITQ policy (but perhaps relates to the species), it is coded as "N."

Table 2 provides data sources utilized in this analysis. Column one provides the agency or source from which the data was obtained. Column two provides a description of the types of data obtained from the source, and column three provides details on the actual data used in this analysis. All public comments were obtained from NPFMC meeting minutes, meeting binders, or meeting transcripts. The public comments were gathered through correspondence with council staff or by visiting the NPFMC office in Anchorage and making copies of all meeting materials. To the best of my knowledge, the data described above represents the entire population of public participants for the period 1987 to 1992. There are a total of 8,646 unique vessel owners harvesting halibut or sablefish any year during the study period. Of these vessel owners, 835 participated in the policy formation process a total of 1130 times.

Variable Construction

Between 1987 and 1992, the ITQ program design made large changes in the way quota was to be initially allocated. Major changes in the initial quota allocation formula, qualifying criteria, and planned implementation date are provided in table 3. Sablefish and halibut ITQ plans change slightly through any given year, but there are essentially five different ITQ design plans that are seriously examined during the sample time period (1987-1991). The initial quota allocation scheme was changed on an annual basis. As the ITQ policy evolved, the qualifying period for quota allocation (years from which your quota is

calculated) became more inclusive. The qualifying period for quota allocation was updated on a yearly basis to account for new entry and more recent participation.

For vessel owner harvesting halibut or sablefish during the period 1987-1991, expected quota allocation (EQ) is calculated for each period according to the allocation formula as described in table 4. Each vessel owner's expected future catch (EC) is calculated as an average using only participating years (no zero catch years). The difference in these two numbers represents change in wealth under ITQ management (Diff). Harvesters will update their expected future catch based on catch information from the most recent year's harvest. A harvester's expected quota allocation changes based on changes in the allocation formula, qualifying years and participation requirements.

The distance from the vessel owner's city of residence to meeting location, D, is also recorded for each round. The cost of attending a meeting is assumed to be proportional to the distance from the vessel owner's city of residence to the meeting location. The cost of participation is measured in terms of distance to Anchorage. The distance of a vessel owner's city of residence to the meeting location (Anchorage, Alaska), is found using Google maps distance calculator.

Given the change in expected difference in expected earnings under status quo versus ITQ and cost of participation, the harvester will form preferences for the policy and will choose to abstain or participate in the formation of policy. If the individual participates, Y is equal to 1, and 0 otherwise.

IV. Analysis of Participation Data

Although only 10.1% of vessel owners participated in the political process of developing the ITQ program, these participants account for 37% of landings value for the period of 1984-1991. Participating owners own 12.75% of all sablefish and halibut harvesting vessels. On average, higher intensity political participants have higher average total landings, in terms of weight and value. This is especially pronounced for meeting participants that on average land 4-10x as much as non-participants (Table 7). Overall, 72% of the participating vessel owners expressed preferences against ITQs (Table 6). However, mode of participation is highly correlated with position. Nearly 40% of observations are petition records and almost all petition observations are opposed to ITQ management (98%). Conversely, only around 54% of letter writers and 46% of meeting participants oppose, as seen in table 6. Table 8 shows the expected difference in expected catch and expected quota as a percentage of the total allowable catch for participants and non-participants by each round. This is the Diff term described in the data section. For every round except the last, participants have a larger difference in expected catch under the two regimes relative to non-participants. These numbers seem very small, but when multiplied by the total allowable catch to get an actual quantity in pounds, the affect is more apparent. Based on 1990 numbers, a reduction in expected catch of 0.00005% translates to roughly 2,600 pounds of halibut ($4700).

V. Discussion

Self-interest, influence, and cost are important factors influencing participation in the fisheries management process. Expected benefits change as a result of changes to the initial allocation formula, and the timing of these benefits also change. As the quota allocation

formula changes during the formation process, so do the individual's expected quota allocation and expected future catch. We compare the expected change in benefits of participants versus non-participants and find that participants typically have more at stake than non-participants. That is, they have on average, a larger difference between expected catch and expected quota (Table 8). This is in line with previous empirical literature finding self-interest as an important determinant of political participation.

The amount of influence an individual exerts over the council process is likely partially attributable to the mode of participation. Testifying at a public meeting is the most visible form of participation, and likely the most influential. The decision making of policy makers is more in line with the preferences expressed by meeting participants than other types of political participants.[20] However, consolidation caps limiting the amount of quota that can be held by one individual, and transferability restrictions prohibiting trading of permits between vessels in different size classes were included to address concerns highlighted by stakeholder input. Consistent with the literature, meeting attendees are larger, and therefore likely higher SES, than other types of participants and non-participants.

The final policy was approved in December 1991, and forwarded to the secretary of commerce in April of 1992. As ITQ implementation became more salient in council discussions, participation increased. The fourth column in table 5 shows the number of participants per year. Throughout the policy formation process, the council made many requests to the public for input. Even though the policy was not implemented until 1995, participation started to decline with final council adoption in 1992. This likely signaled to

[20] The ITQ policy was approved even though a majority of political participants opposed the policy.

stakeholders that the probability of influencing the outcome was significantly reduced. This finding is also in line with previous literature suggesting "closeness" of an election increases participation.

Although we have not yet examined distance in relation to participation, we do observe participation rates to be inversely related to the cost of participation. The most popular mode of participation, signing a petition, is also the one that requires the least effort. Resource models of participation would suggest that writing a letter requires more civic and communication skills than signing a petition. We find letter writing to be a less popular mode of participation than signing a petition. Attending a meeting is the most costly and least common form of participation,

This paper reviews political participation literature and analyzes political participation in the context of the Alaska halibut and sablefish fisheries. The ITQ policy formation process is described, and expected determinants of participation are discussed. We utilize observable variables in fisheries performance and demographics to examine the sources of variation in political participation. Our work demonstrates the importance of self-interest, influence, and cost in determining political participation. It is important to study political participation beyond the context of elections. The social norms that lead to participation in electoral politics do not always lead to participation in broader forms of political activity (Dalton, 2008).

VI. Figures and Tables

Tables

Table 1: Timeline of ITQ development

Year	Month	Council Action
1987	December	Council states intent to develop LE or ITQ for sablefish fishery.
1988	December	Council to expand and analyze two options for sablefish management: ITQs and license limitation.
1989	October	Sablefish Management Alternatives Go to Public Review; Halibut ITQ management review scheduled for Jan 1990
1990	January	ITQs Considered Preferred Alternative for Sablefish Fixed Gear Management
1990	April	Decision on sablefish ITQ delayed and later tabled.
1990	December	Halibut added to Sablefish ITQ program
1991	October	Council approves preferred alternatives for ITQ program for the sablefish and halibut fixed gear fisheries.
1991	December	Council approves ITQ system for the fixed gear sablefish and halibut fisheries.

Table 2: Data Description (Years 1987-1992)

Source	Description	Details	Managing Agency
NPFMC Meeting Minutes	Minutes of council meetings covering proposed changes to management.	Name, location, agency, comment, date	NPFMC
NPFMC Newsletters	Quarterly public newsletter providing changes to FMPS and agenda items for upcoming meetings. Includes upcoming events, forums, and fishery news.	Proposed/Implemented changes to FMP	NPFMC
ADFG Fish Tickets	Log of all landings made in the state of Alaska.	ADFG number, species landed, weight, value, port, year and month of landings	ADFG
Alaska State Vessel Registry	Listings of vessels licensed by the state of Alaska to participate in commercial fishing activities.	ADFG and file number, owner name, address, phone, vessel details, years of ownership, home-port	CFEC

Table 3: ITQ Policy Design Details

Species	Time Period	Start Date	Participation Requirement	Qualifying Years	Quota Calculation
Sablefish	1987-1988	1991	1984, 1985, 1986 or 1987	1984-1987	Average or best of historic landings.
Sablefish	1989	1991	1984, 1985, 1986 or 1987	1984-1988	Average or Best of historic landings.
Halibut and Sablefish	1990	1991	1984, 1985, 1986, 1987 or 1988	1984-1989	Average of 6 years landings, more credit for recent participation.
Halibut and Sablefish	Late 1991-1995	1993	1988, 1989, or 1990	1984-1990*	Best five years from the qualifying period.

*Historical catch of sablefish will be counted from 1985-1990. Historical catch of halibut will be counted from 1984 -1990.

Table 4: Variable Names and Descriptions

Variable Name	Description	Calculation
EC	Expected catch	Average percent of TAC landed (total weigh) for participating years.
EQ	Expected quota allocation	Using formula from table 2.
Diff	Difference in Expected catch and expected quota allocation.	Expected Catch-Expected quota allocation
D	Distance	Aerial Miles from Anchorage, AK
City	City of Residence	City of residence fixed effect.
Year	Year of Observation	Year fixed effect.
Y	Participation Measure	Binary Variable equal to one if individual participates.

Table 5: Position by Year of Comment.

	Oppose	Support	Undecided	Total
1982	0	3	0	3
1987	5	5	4	14
1988	16	19	15	50
1989	23	17	32	72
1990	131	38	11	180
1991	389	56	8	453
1992	193	82	3	278
1993	3	2	0	5
1994	7	0	2	9
1995	1	4	1	6
Total	768	226	76	1,070

Table 6: Position by Mode of Participation

	Oppose	Support	Undecided	Total
Letter/Written	236	163	32	431
Petition	464	9	0	473
Public Testimony	67	54	40	161
Resolution	3	0	0	3
Total	770	226	72	1,068
	72.10%	21.20%	6.70%	

Table 7: Average Cumulative Landings (Lbs)* by form and round participation

		Round 1	Round 2	Round 3	Round 4	Round 5
Sablefish	Abstain	30,587	35,791	40,900	41,704	45,814
	Petition	-	-	-	97,525	62,980
	Letter	30,549	129,468	51,707	291,351	187,558
	Public Testimony	387,631	1,395,991	707,962	1,271,375	479,825
Halibut	Abstain	31,836	35,748	39,120	38,353	39,540
	Petition	-	-	-	256,993	139,159
	Letter	222,561	109,619	85,267	155,353	175,504
	Public Testimony	190,846	367,381	263,800	416,195	260,479

*Cumulative landings are total landings from 1984 up to that point in time

Table 8: Average Difference in Expected Catch and Expected Quota by Participation

		Round 1	Round 2	Round 3	Round 4	Round 5
Sablefish	Non-Participant	2.90E-04	3.10E-04	3.40E-04	3.80E-04	4.30E-04
	Participant	5.00E-04	6.40E-04	1.10E-03	8.30E-04	4.10E-04
Halibut	Non-Participant	5.60E-05	6.40E-05	7.70E-05	8.10E-05	8.80E-05
	Participant	2.30E-04	2.10E-04	1.80E-04	2.20E-04	1.60E-04

*Differences calculated as a percent of the total allowable catch

Figures

Figure 1: Example Letter

AGENDA C-4
JUNE 1990
SUPPLEMENTAL I-114

RECEIVED
JUN 23 1990

June 19, 1990

Mr. Don Collinsworth, Chairman
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
P. O. Box 103136
Anchorage, Alaska 99510

Dear Chairman Collinsworth:

I would like to go on record as being actively opposed to the implementation of an individual fishing quota system for sablefish in Alaska.

The system as proposed would be detrimental to the coastal communities and to the fishing industry. I believe that if the IFQ plan were to be approved by the Council, that the entire nature of the fishery would change and the losers would be Alaskans.

I urge you not to approve the proposed IFQ method for management of our sablefish fishery.

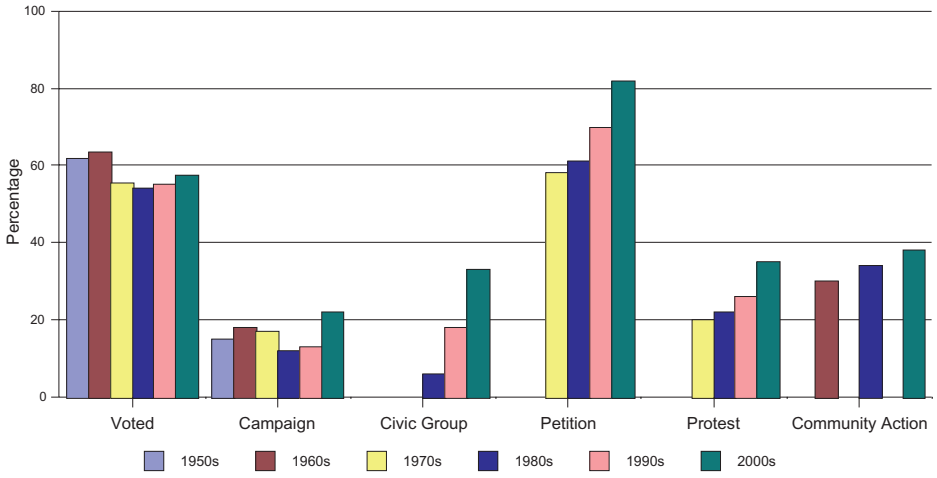
Sincerely,

KODIAK FISHERMAN
MARC [redacted]
[redacted] KODIAK, AK
99615

Marc [redacted]

Figure 2: from Dalton, 2008

Figure 2: Trends in American Political Participation



Sources: Voting: average of presidential turnout (VEP) from http://elections.gmu.edu/voter_turnout.htm; campaign activity: participated in two or more campaign activities, ANES time series; civic group: member of at least one public interest group, WVS (1980, 1990, 1999); petition: signed a petition, Political Action Survey, WVS (1980, 1990, 1999); protest: participated in one of four challenging acts, WVS (1980, 1990, 1999); community action: worked with group on local problem, Verba/Nie 1967, 1987; Social Community Survey 2000.

Chapter III

The Cost of Efficiency: Consolidation in Alaskan ports after the introduction of fishing property rights

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Abstract:

Arguments against the adoption of fishery property rights, despite their clear ecological and economic benefits, include the redistribution of fishing income away from small communities and the increased concentration of fishing effort among fewer vessel owners. We examine the extent to which these effects have occurred after the implementation of transferable fishery property rights in the Alaskan halibut and sablefish fisheries. We find that fishing ports generally do not lose harvesting or processing revenue, but both processors and vessel owners consolidate, and fewer fish are delivered to the home ports of vessel owners. As a result, small coastal cities where halibut and sablefish are landed see a reduced number of vessel owners and overall population declines. While there is reason to believe that this realignment may create substantial aggregate welfare gains, our results offer a partial explanation to the political opposition to transferable property rights to fish.

I. Introduction

In natural resource management, the reallocation of property rights to eliminate open access losses is often met with resistance, and often inefficient institutions persist. When changes in policy also result in a change in distribution of wealth, even the most efficient policies can be politically infeasible. In many settings, successful policy adoption requires a trade-off between efficiency and distribution. In a common pool resource setting, the transition to secure, tradeable property rights can be economically beneficial and improve the health of the resource, but is often met with resistance. Cap-and-trade for CO2 emissions may be opposed by industry, environmental groups, and others who perceive costs from the more efficient regulatory regime negatively affecting them (Stavins 1998). The redistribution of water from agricultural to urban and environmental purposes is opposed by rural communities who claim such transfers cripple local economies (Edwards and Libecap 2016; Hanak 2005).

Similarly, in fisheries the switch from regulated open access to tradable property rights has been opposed (Grainger and Parker 2013). A variety of property rights based management are used in fisheries: territorial use rights in fisheries (TURFs); individual transferable and non-transferable quotas (ITQs and IQs); cooperative and community fishing rights; and entry licenses. An ITQ program typically defines property rights in harvesting volume as a percentage of the total allowable catch. ITQ rights are often exclusive, permanent, secure, and transferable. Because an individual is given decision making power and ownership over the resource, harvesters adjust effort and fishing capital to capture their allocated quota at a minimum cost (Arnason, 2006). The ITQ harvester can also change the

timing and location of landings in response to market conditions or to increase product quality.

However, ITQs have encountered a considerable amount political opposition despite their well-documented improvements of harvesting efficiency and fishery health. Analysis of nearly 4,000 letters stating opinions on fishing property rights in Alaska indicates the loss of fishing income to rural ports and the consolidation of fishing wealth are key concerns of fishermen, crew, seafood processors, and community leaders and members prior to their implementation (Sutherland 2016). Aggregate efficiency gains after ITQ introduction are expected in the harvesting sector (Weninger 2008; Weninger & Waters 2003). ITQs increase fleet efficiency through three mechanisms: reducing restrictions on the harvesting sector; consolidation of more harvesting activities under the lowest cost (most efficient) operators; and the additional flexibility for vessels to exploit scale economies in production (Lian et al 2009).

While it is widely acknowledged that fishery property rights increase the efficiency by which the resource is extracted, the distribution of gains under the new management regime is not well understood. Prior work has primarily focused on the theoretical drivers of consolidation and empirical analysis of the extent to which fleets increase technical efficiency in production as a result (e.g. Lian et al 2009; Grafton et al; Reimer et al 2014), There has not been statistical analysis of the effects of these changes on individual fishing communities. Similarly, there has not been statistical analysis of processor response to the introduction of property rights at the community level. If ITQ skepticism centers around these effects, then it is critical to understand to what extent this opposition is grounded in empirical reality.

This paper addresses the effect of ITQ implementation at the community level by examining the effect of the 1995 introduction of property rights in the Alaskan sablefish and halibut fisheries. It examines how the number of processors and harvesters, the overall revenue from both sectors, the allocation of deliveries to local ports, and population changed as a result of the changing management regime. We present a simple analytical framework to explain why transferable quotas are expected to increase the concentration of fishing income among a smaller number of vessels and processors. We use a novel dataset, constructed by merging data on fish deliveries with vessel and owner information, to test the changes using a difference-in-difference approach. We demonstrate that while fishing and processing revenues do appear to increase slightly or remain constant overall, property right introduction has large effects: (1) both the harvesting and processing sectors consolidate; (2) vessel owners deliver less to their home ports; and (3) the population of small halibut and sablefish ports declines. We conclude by arguing that these changes, while potentially increasing efficiency, are also likely to lead to opposition prior to and dissatisfaction after implementation among certain groups.

II. Background

Consolidation and Opposition

Institutional arrangements that reduce common pool losses, such as secure, transferable property rights will only arise if politically feasible. The amount of political conflict will partly depend on the concentration of wealth under the proposed and current share distribution (Libecap, 1993 pgs 24, 28). When some parties are made worse off under new allocation of rights, they may oppose adoption and implementation. Local fishing

communities have opposed ITQs over concern that ITQs will lead to fleet consolidation and a loss of jobs (Grainger & Parker, 2013). The observed structure of post-ITQ fisheries confirms some community and industry concerns. Under ITQ management without trading restrictions, quota sales result in a smaller, more efficient fleet as compared to regulated open access without entry restrictions (Reimer et al 2014).

Ex-ante analysis shows cost savings resulting from ITQ programs can largely be attributed to fishery consolidation through exit of inefficient vessels (Lian et al. 2010, Weninger 2008, Weninger & Waters 2003). These predictions have been confirmed in ex-post analysis finding cost savings achieved through consolidation (Grafton et al. 2000). Small, local operations may benefit from traditional regulation, while larger operations have more consistent and larger catch over time, and are often the biggest advocates of limited entry (Sutherland 2016). The New Zealand quota management system (QMS), adopted in 1986, resulted in fleet downsizing with exiting vessels being predominantly small-scale fishers (Stewart et al, 2006). Massive fleet consolidation in the Icelandic cod quota system resulted in public naming of quota holders as "Lords of the Sea" (Pálsson and Helgason 1995). A reduction in fleet size concentrates vessel revenue, and results in broader impacts in fishing industry employment. When the Canadian halibut fishery adopted ITQs, efficiency increased but landings shifted and dropped as much as 12% in some ports as their freezing facilities became unnecessary, and the number of crew-members employed dropped by 32% (Casey et al., 1995). In the Bering Sea/Aleutian Islands crab fisheries, the reduction in fishery employment after ITQ implementation was proportional to the number of vessels exiting the fleet (Abbott et al, 2010).

Due to potential distributional impacts of fleet consolidation, most of the current ITQ programs restrict trading of quota within vessel classes and cap consolidation of quota. The owners of the grandfathered quota are typically allowed to sell quota with restrictions aimed at maintaining diversity and limiting consolidation of the fleet. Prior research shows how ITQ design affects the distribution of benefits among and within sectors (Matulich and Sever, 1999; Costello and Grainger, 2015). However, there is little empirical analysis.

Empirical Setting

Commercial harvest of halibut can be traced back to the early 1900s, and the fishery mostly produced fresh-fish until the 1970s (Homans and Wilen, 2005). Higher halibut prices in the 1970s and the implementation of limited entry programs for salmon fisheries contributed to the growing number of vessels entering the halibut fishery. During the 1980s, the halibut fishery received an influx of larger crabbing vessels as crab stocks declined (Shotton, 2001). Even as the total allowable catch stayed steady or increased, the season length shortened due to an increasing number of vessels entering the fishery (Willam et al., 2009). The halibut fishery experienced growth when other fisheries experienced low years, and the relatively low cost of entry into the fishery also made the halibut attractive as a "supplemental" fishery. By 1992 the halibut season had been reduced to two or three one-day openings.

After the creation of the exclusive economics zone in 1976, the US sablefish experienced enormous growth. Similar to the halibut fishery, the sablefish fishery attracted an increasing number of vessels from 1980 to 1990. The council first adopted allocative measures for sablefish in 1985, when the total allowable catch was split between geographic areas and gear types (Pautzke and Oliver, 1997), but the advent of new fishing technology,

increasing vessel size, and increased entry led to further growth of the sablefish fishery. Season length regulations were implemented in the fishery, and the sablefish season had been reduced from 180 days to 20 days in some areas. As a result of over-capitalization and increased entry, regulators suggested ITQs as a potential management regime for sablefish in the late 1980s. During the policy formation period of the sablefish ITQ, similar concerns in the halibut fishery led to the two fisheries being combined in the implementation of the policy in 1995.

The halibut and sablefish fisheries often overlap, as both require use of longline gear and similar vessels. However, sablefish are harvested further off the coast at depths of 1300ft, requiring larger vessels and more specialized gear than halibut harvesting. Halibut are a flatfish caught in waters as shallow as 90 feet, allowing vessels as small as skiffs to harvest halibut close to shore. Sablefish vessels are on average larger than halibut vessels, and a few large vessel operators target exclusively sablefish. Most of these fishers operate vessels 60 feet or more in length, enabling them to fish in less-protected areas, such as the Bering Sea and Aleutian Islands (Willman et al., 2009). Fewer barriers to entry exist in the halibut fishery leading to a more severe derby setting under regulated open access management. For this reason, the halibut fishery is expected to respond more to the introduction of property rights.

Pre-ITQ command and control regulations resulted in a race to fish in which vessels and gear were chosen to maximize quantity harvested in a short time period (Homens and Wilen 2005). The number of vessel owners participating in the halibut fishery grew from 2,479 in 1985 to its maximum of 4,161 in 1991. For sablefish, the annual number of vessel owners ranged from 820 in 1990 to 1,271 in 1994. As a response to over-capitalization and

safety concerns, ITQ programs were floated for the sablefish and halibut fisheries during the late 1980s and early 1990s. The ITQ programs were finally implemented in 1995, with initial allocation of quota based on average fishery landings during the qualifying period 1984 through 1990. Like most other ITQ programs, the Alaska halibut sablefish ITQ program included quota trading restrictions and ownership caps. Quota trading restrictions and concentration caps are more stringent for the halibut fishery, but in both fisheries considerable opportunity for consolidation existed under the ITQ rules. From 1994 to 1997 the number of vessel owners dropped for both fisheries by about 46%. During the same period, total ex-vessel revenues increased by 29% for halibut and 16% for sablefish. As revenues increased, the number of individuals receiving the revenue decreased. Figure 1 shows the total number of vessel owners from 1990 to 2000. Figure 2 shows the total revenue over time, and Figure 3 the per-harvester revenue.

III. Model

We begin by examining the effect of a transition from regulated open access to ITQ management. In this transition we assume the total allowable catch (TAC) is set in a manner that does not change when ITQs are introduced. In any period, a vessel has harvest y_i. We assume harvest follows the Schaefer representation where: $y_i = qe_iX$ where q is the catchability coefficient, X is the stock of biomass, and e_i is the level of effort. Given an identical set of some unknown number of harvesters, N:

$$TAC = Ny_i = Nqe_iX \tag{1}$$

Therefore, $e_i = \frac{TAC}{NqX}$ and $y_i = \frac{TAC}{N}$. Under regulated open access given an ex-vessel price p and a cost of effort function $c(e_i)$, rents are dissipated so that:

$$\pi_i = py_i - c(e_i) = pqe_iX - c(e_i) = 0 \tag{2}$$

Under ITQs:

$$\frac{\partial \pi_i}{\partial e_i} = pqX - c'(e_i) = 0 \tag{3}$$

Then e_i^{OA} satisfies the average cost condition:

$$\frac{c(e_i)}{e_i} = pqX \tag{4}$$

While e_i^{ITQ} satisfies the marginal cost condition:

$$\frac{\partial c(e_i)}{\partial e_i} = pqX \tag{5}$$

Therefore, $e_i^{OA} < e_i^{ITQ}$, implying that $N^{OA} > N^{ITQ}$. This leads to prediction (i): The harvesting sector consolidates after ITQs are implemented.

Fleet consolidation results in fewer vessels participating in the fishery. These vessels take longer to catch the TAC, and therefore the rate of deliveries to processors decreases. Let z_i be the quantity of fish processed by one of M identical processors. Under regulated open access the number of processors, M^{OA} satisfies the condition of long-run average cost equaling marginal cost:

$$\frac{c(z_i)}{z_i} = \frac{\partial c(z_i)}{\partial z_i} \qquad 6)$$

If this condition were not satisfied, another processing firm could enter and earn profits. This conditions restricts the number of processors even under competitive equilibrium. Even though the firms are price takers, they must be large enough to reach the minimum efficient scale, limiting the number of firms. When ITQs are introduced, deliveries occur over a period T times longer than before. Therefore, the number of processors, M^{ITQ} satisfies the condition:

$$\frac{c\left(\frac{z_i}{T}\right)}{\frac{z_i}{T}} = \frac{\partial c(z_i)}{\partial z_i} \qquad 7)$$

That is, the quantity determining the minimum efficient scale in the processor cost function under regulated open access was delivered over a short period, and if the quantity is delivered over a longer period, more must be delivered for the processor to reach the minimum efficient scale. This leads to prediction (ii): The processing sector consolidates after the introduction of ITQs.

Under regulated open access, there are a large number of vessels catching relatively small amounts of fish. For these vessel owners, the fixed cost of traveling to a destination remote from their city of residence to fish or deliver product—for instance to a processor offering a higher price—might not be worthwhile. However, after consolidation vessel owners prosecute more fish on average, so that incurring the cost of remote operations may prove profitable. The leads to prediction (iii): Vessel owners make fewer deliveries to their home ports after ITQ introduction.

An element of the inefficiency of regulated open access is excess labor input. In small communities whose economies are tied to halibut and sablefish prosecution, a decrease in the number of owners and processing plants will cause a downward shift in the labor demand curve relative to other locations, causing outward migration to seek alternative employment. This leads to prediction (iv): Small community populations decline as a result of ITQ introduction.

IV. Data and Empirical Strategy

Data

The variables used in our data set represent potential indicators of changes in revenue flows, industry structure and community well-being. These measures are constructed using the Alaskan Vessel Registry, Alaska Department of Fish and Game (ADFG) fish tickets, and the Commercial Operators Annual Report (COAR). Vessel owners in the state of Alaska are required to register their vessel in a database. A unique file number identifies every individual or entity owning a vessel, and vessels are given a unique vessel number. The number of vessels harvesting halibut or sablefish varied by year, peaking in 1990-1991 and decreasing over the sample period. When harvesters land fish in Alaska, they are required by law to fill out fish tickets, providing vessel and catch information including vessel number, date, and weight and value landed. An additional dataset, COAR, tracks both ex-vessel landings and price, as well as the wholesale weight and price of products sold by processor. This ex-vessel data is less reliable than fish ticket data, but is the only source of data for processors. This dataset is used to track the number and revenue of processors through the period 1990-2000.

Landings data are linked to the vessel registry using unique vessel number (ADFG number), making it possible to track the harvest and location of all vessel owners that participate in the fishery over the study period. The unit of observation is the port/city, and location and value of fish landings are tracked by city of residence of the vessel owner. For each Alaskan port city, we construct a variety of measures used to estimate halibut and sablefish revenue flows through processors, vessel owners and fish landings.

Table 1 describes the variables used in the empirical analysis, and all variables except the last three are calculated for each fishery of interest, e.g. each port has a count of halibut processors and of sablefish processors. Variables include: the number and total revenue of processors by port city; and the number, total revenue, and average revenue of vessel owners by city of residence. We construct a measure of the percent of catch delivered to home port by taking the amount of catch caught by residents of a city compared to what they deliver there. To measure community effects of ITQs, we utilize the "Alaska Taxable" data from Department of Community and Regional Affairs for years 1990-2000. This provides us with annual population measures of 355 Alaskan cities and communities.

Finally, we construct two dummy variables. First, we construct an ITQ indicator if the year is after 1994. Second, we use vessel ownership and harvest data to categorize cities as a halibut ports (=1) or not (=0). If vessel owners harvesting halibut reside in a given city for all years in the pre-ITQ period (1990-94), they are categorized as halibut cities. The set of sablefish cities is contained in the halibut set, so the halibut set is used exclusively.

Empirical Strategy

We test four predictions: (i) harvester consolidation, (ii) processor consolidation, (iii) fewer home port deliveries, and (iv) population declines in halibut port cities. We employ a

difference-in-difference estimation strategy with observations at the city/port level. The baseline/counterfactual fishery is pacific cod. This fishery was selected for several reasons. First, wholesale pacific cod is a substitute for sablefish (also called black cod) and halibut and therefore will be sensitive to changing market dynamics. Second, pacific cod was and continues to be a regulated open access fishery and its management did not change in 1995. Third, pacific cod is harvested using trawl, longline, and pot gear, which overlaps with the primarily pot gear used to prosecute sablefish in the Bering Sea and longline gear used to prosecute halibut as well as sablefish in the Aleutians and Gulf of Alaska (Witherell and Peterson 2011). Equation 8 provides the general form of the data analysis. The log of the variable of interest is regressed on dummy variables for fishery type and ITQ while controlling for year fixed effects, any variation affecting all ports within a given year:

$$\log(\mathrm{Y}_j) = \sigma + \sum_{f \in \{H,S\}} \left(\gamma_f \cdot \mathrm{I}_f + \delta_f \cdot \mathrm{I}_{ITQ} \cdot \mathrm{I}_f\right) + \tau_t + \mathrm{u_j} \qquad (8)$$

Here, σ is the baseline effect of the counterfactual fishery, while the baseline effect of ITQ introduction is absorbed by the year fixed effects. The dummy variables I_f are one when an observation is from a given fishery, where $f \in \{H, S\}$ represents halibut and sablefish fisheries, and zero otherwise. The coefficient γ_f controls for the pre-ITQ difference between halibut or sablefish and pacific cod, prior to ITQ introduction. To test prediction (ii) we regress measures of processor consolidation—processor revenue by city and number of processors—in equation 8. The coefficient on the interaction between I_{ITQ} and I_f, the post ITQ effect on a fishery, halibut or sablefish, relative to pacific cod is of interest. While there is not a clear prediction on total revenue, we expect that for the log of the number of processors δ will be significant and negative.

To test hypothesis (i), harvester measures—total vessel owner revenue, average vessel owner revenue per city, number of vessel owners per city—are regressed. Again, there is not a clear prediction for δ on total revenue, but number of owners is expected to be negative, and average revenue per owner is expected to be positive. More robust specifications control for city/port fixed effects, the variation through time that is unique to a port, p_j, and port specific time trend, $t \cdot p_j$, as shown in equation 9.

$$\log(Y_j) = \sigma + \sum_{f \in \{H,S\}} \left(\gamma_f \cdot I_f + \delta_f \cdot I_{ITQ} \cdot I_f\right) + \tau_t + p_j + t \cdot p_j + u_j \quad (9)$$

To test prediction (iii) the same specification is used but with the dependent variable being proportion of catch delivered to home port with no log transformation. The prediction here is that δ will be negative, especially for halibut, as fewer deliveries are made to home ports. Finally, equation 10 shows a test for prediction (iv). Here the proportion of a city's 1990 population is regressed on a dummy for if the port has residents who fish halibut in every year 1990-94.

$$P_j = \sigma + \alpha \cdot I_{ITQ} + \beta \cdot I_{port} + \sigma \cdot I_{ITQ} \cdot I_{port} + \tau_t + p_j + u_j \quad (10)$$

When τ_t is controlled for with a year dummy, the variable I_{ITQ} is dropped. p_j controls for port fixed effects. The coefficient σ will be negative if halibut ports lose population relative to non-halibut ports post ITQ introduction.

V. Results

The implementation of ITQs in the Alaskan halibut and sablefish fisheries brought about dramatic changes in the number of participants and distribution of revenue among

fishing industry members. Reductions in the number of vessel owners, active vessels, and processing plants were accompanied by a relative decrease in population for small, fishery-dependent communities. Table 3 shows the pre- and post-ITQ means of the two species of interest, halibut and sablefish, as well as pacific cod which did not undergo any regulatory change. These statistics indicate that Wholesale Revenue, Mean Owner Revenue, and Mean Average Owner Revenue increased in treated fisheries, but only Wholesale Revenue increased in the untreated fishery. Similarly, Number of Processors, Mean Number of Owners, and Mean Home-Port Deliveries decreased for treated fisheries, but increased or stayed the same for the untreated fishery. While this table is consistent with our hypotheses, it is indicative only. To more rigorously show these results, we turn to statistical tests.

Prediction (i) states the harvesting sector consolidates after ITQs are implemented. Tables 4a and 4b shows the effect of ITQs on a city's total and average owner revenue received from halibut or sablefish harvesting. Specifications (1-4) examine the effect of ITQs on city total revenue. Though the signs on the coefficients interacting ITQ and halibut or sablefish are positive, the result is only significant for sablefish when omitting port fixed effects and port time trend. Consistent with the prediction, average revenue per owner significantly increases for both halibut and sablefish vessel owners post-ITQs. Average owner revenue increases by 120% for Halibut and 94% for Sablefish.

Table 5 provides regression results for tests of Predictions (i) and (iii). The sign on the coefficient of the ITQ interaction term is consistently negative for both halibut and sablefish, indicating the number of operating vessel owners per city decreases when ITQs are implemented. The halibut result is significant for all specifications, and significant at the 1 percent level when year and city fixed effects and a port time trend are included. The

coefficient on the halibut ITQ interaction term indicates the number of owners under ITQ management declined to 68.3% of the pre-ITQ total. The coefficient on sablefish ITQ is only significant in specification (2) which includes year and city fixed effects. The number of sablefish owners declined to 80.7% of the pre-ITQ total.

Figure 4 shows the mean home port deliveries for sablefish and halibut cities, indicating a decrease for halibut around 1995. Sablefish also decreases after 1995 after increasing for the early years of the 1990s. Specifications (4) and (5) of table 5 provide results for test of prediction (iii), vessel owners make fewer deliveries to their home ports after ITQ introduction. The sign on the ITQ-species interaction terms is consistently negative and significant at the one percent level for both halibut and sablefish. This implies vessel owners are less likely to deliver to the port at their city of residence post ITQ implementation. Prior to ITQs, halibut vessel owners delivered 72% of their catch to their home port, and sablefish vessel owners delivered about 55% of catch home. Under ITQ management, halibut and sablefish vessel owners reduced the percent of their total catch delivered to home port by 7.5 and 5 percentage points, respectively.

The processing sector also experiences a reduction in number of firms following ITQ implementation. Figure 5 shows the mean trend in number of processors consistent with prediction (ii): sablefish and, more dramatically, halibut ports see decreases in the number of processors around the time the ITQ policy was implemented. Tables 6a and 6b provide results for analysis performed on the fish processing sector. Prediction (ii), the processing sector consolidates after the introduction of ITQs is tested in specifications (1-4). The sign on the ITQ interaction term is consistently negative and significant at the 5 or 1 percent levels. The number of plants per city processing halibut is reduced by 15.3% after ITQs.

Similarly, the number of sablefish processors is reduced to 78.7% of pre-ITQ total. ITQs do not significantly change total processor revenue.

ITQ induced fishery and industry changes, including reductions in number of active vessels, vessel owners, and processing plants, have consequences for small, coastal communities. Figure 6 shows the average population of Alaskan cities under 500 people, by whether a vessel owner in the city lands halibut or not, scaled by the 1990 average city population. Post-ITQ, the population of halibut cities declines relative to the population of other cities. Table 7 provides results of statistical analysis performed on small community populations. Prediction (iv), which states small community populations decline as a result of ITQ introduction, is tested using specifications (1-5). Communities are classified as "halibut cities" if for every year prior to ITQs, at least one city resident owned a vessel that harvested halibut. The effect of ITQs on community population is tested for three population size categories of cities: less than 500, less than 1000, and less than 5000 individuals. Specifications (1-3) test the effect of ITQs on population of cities of less than 500 individuals and is negative and significant at the 5 percent level. The effect of ITQs on cities of less than 1000 individuals, specification (4), is similar to the effect of ITQs on cities of less than 500 individuals. However, the effect is stronger for smaller cities, with a coefficient value of -0.15, indicating small cities where halibut vessel owners live have 15 percent less population relative to the baseline population in 1990.

VI. Conclusion

In this paper we find that fishing ports generally do not lose harvesting or processing revenue as a result of ITQs. Rather, processors and vessel owners consolidate, and fewer fish are delivered to the home ports of vessel owners. As a result, small coastal cities where

halibut and sablefish are landed see a decline in vessel owners and overall population. Fleet consolidation is accompanied by reduced demand for crew, vessel, and port related services. Communities experiencing reduced number of owners lose both fishing owner revenue and vessel-related employment opportunities, likely causing overall population declines when outside employment options are limited.

Quantifying the impacts of ITQs on industry structure and communities provides insight in to why these institutions are not more prevalent. Community and industry members may lose under certain policy designs and will likely oppose its implementation. The Seafood industry is a substantial part of Alaska's economy. Though there are only about 10,000 vessels operating in Alaska in any given year, the seafood industry as a whole employed 78,519 individuals in 2008 (MCA, 2009). ITQs affect employment at the harvesting level and have impacts on downstream industry structure. There have been claims that ITQs directly affect communities, but this claim has not been rigorously examined empirically. ITQs often face opposition prior to and dissatisfaction after implementation. There is a general consensus that property rights based management in fisheries offers benefits in terms of cost savings, stock health, etc, but social consequences of ITQs are still a highly disputed issue (Thébaud et al., 2012).

Understanding downstream and community impacts of ITQs can assist in the design of management institutions, reduce the amount of opposition and the length of time to implementation, and improve overall implementation efficiency. Efficiency gains afforded by ITQs result in redistribution of wealth and consolidation in both the harvesting and processing sectors. This paper confirms the anticipated consolidation resulting from ITQs, and further links ITQ implementation to population changes in small, coastal communities.

While there is reason to believe that this realignment may create substantial gains, our results offer a partial explanation to the intense political opposition to transferable property rights to fish catch. Policy can be designed to minimize these effects. For instance, consolidation caps and transfer restrictions prevent the fleet from consolidating to its least cost size. While these may improve community buy-in, they also entail, and should be weighed against, the potentially significant efficiency costs. Side-payments in the form of community quota allocations may also improve public buy-in. Although both consolidation caps and community allocation were part of the sablefish and halibut ITQ design, consolidation and community effects still occur. However, voluntary exit from the harvesting sector does not in itself imply any one is worse off. In fact the exiting fisher gets compensation in the form of payment for her quota. The indirect employment effects of harvester exit on communities and processors are real and need to be accounted for in policy design to achieve political feasibility.

VII. Sources

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VIII. Tables and Figures

Tables

Table 1: Variable Descriptions

Variable Name	Description	Source
Owner Revenue	Total sales of a species by residents of a city/port	Fish tickets
Wholesale Revenue	Total sales of processed fish in a port	COAR
Number of Owners	Total owners fishing a species who reside in a city/port in a year	Fish tickets/registry
Number of Processors	Total processing plants in a port in a year	COAR
Average Owner Revenue	Owner Revenue / Number of Owners by city	Fish tickets/registry
Home-Port Deliveries	Port average of the percentage of landed pounds each individual delivered to their home port	Fish tickets/registry
Population	Port/city population	Alaska Department of Community and Regional Affairs
ITQ Dummy	=1 if year>1994	
Halibut Port Dummy	=1 if port has a halibut vessel owner every year 1990-94	

Table 2: Summary statistics

	Halibut	Sablefish	Pacific Cod
Wholesale Revenue	24,500,000	11,600,000	56,400,000
	(69,800,000)	(24,300,000)	(210,000,000)
Number of Processors	2.40	2.18	2.18
	(2.00)	(1.85)	(2.01)
Mean Owner Revenue	2,642,790	4,017,501	2,061,796
	(7,139,606)	(7,289,831)	(5,262,507)
Mean Average Owner Revenue	27,416	84,259	34,772
	(37,355)	(86,074)	(74,211)
Mean Number of Owners	61.75	32.03	30.28
	(85.26)	(43.68)	(46.78)
Mean Home-Port Deliveries	0.70	0.60	0.79
	(0.04)	(0.03)	(0.02)

Table 3: Pre- and Post-ITQ mean comparisons

	Halibut		Sablefish		Pacific Cod	
	Pre	Post	Pre	Post	Pre	Post
Wholesale Revenue	22,400,000	26,000,000	11,100,000	12,000,000	31,300,000	76,400,000
	(61,700,000)	(75,400,000)	(25,400,000)	(23,500,000)	(98,100,000)	(266,000,000)
Number of Processors	2.57	2.28	2.35	2.04	2.05	2.28
	(2.13)	(1.89)	(2.10)	(1.61)	(2.04)	(1.99)
Mean Owner Revenue	2,005,552	3,113,940	2,844,376	5,202,974	2,064,124	2,059,807
	(3,714,786)	(8,840,533)	(5,220,666)	(8,777,405)	(4,588,503)	(5,795,438)
Mean Average Owner Revenue	15,883	35,944	50,279	118,597	42,859	27,859
	(12,705)	(46,276)	(40,885)	(104,475)	(97,729)	(44,671)
Mean Number of Owners	84.20	45.14	34.88	29.15	30.25	30.30
	(102.91)	(64.86)	(46.72)	(40.43)	(40.40)	(51.78)
Mean Home-Port Deliveries	0.75	0.67	0.63	0.58	0.79	0.79
	(0.02)	(0.02)	(0.02)	(0.01)	(0.03)	(0.01)

Table 4a: Revenue regressions by vessel owner city (1990-2000)

	(1)	(2)	(3)	(4)
VARIABLES	Log Revenue	Log Revenue	Log Revenue	Log Revenue
Halibut	2.861***	3.510***	3.589***	
	(0.639)	(0.606)	(0.624)	
Sablefish	2.922***	3.085***	3.102***	
	(0.679)	(0.678)	(0.698)	
Both				3.328***
				(0.613)
ITQ x Halibut	0.222	0.448	0.385	
	(0.445)	(0.382)	(0.356)	
ITQ x Sablefish	0.983*	0.608	0.585	
	(0.521)	(0.390)	(0.431)	
ITQ x Both				0.534
				(0.349)
Observations	810	810	810	810
R-squared	0.225	0.676	0.707	0.674
Year FE	Yes	Yes	Yes	Yes
Port FE	No	Yes	Yes	Yes
Port Time Trend	No	No	Yes	No

Cluster robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4b: Revenue regressions by vessel owner city (1990-2000)

	(5)	(6)	(7)	(8)
Variable	Log Average Revenue	Log Average Revenue	Log Average Revenue	Log Average Revenue
Halibut	1.978***	2.044***	2.078***	
	(0.499)	(0.477)	(0.497)	
Sablefish	2.628***	2.824***	2.857***	
	(0.561)	(0.561)	(0.574)	
Both				2.381***
				(0.514)
ITQ x Halibut	0.592**	0.857***	0.792***	
	(0.279)	(0.249)	(0.246)	
ITQ x Sablefish	0.866***	0.712**	0.665**	
	(0.315)	(0.281)	(0.309)	
ITQ x Both				0.746***
				(0.236)
Observations	810	810	810	810
R-squared	0.318	0.652	0.667	0.637
Year FE	Yes	Yes	Yes	Yes
Port FE	No	Yes	Yes	Yes
Port Time Trend	No	No	Yes	No

Cluster robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Number of owners and deliveries to home port by vessel owner city (1990-2000)

Variable	(1) Log Count	(2) Log Count	(3) Log Count	(4) Log Count	(5) Percent Home	(6) Percent Home
Halibut	0.947***	1.221***	1.282***		-0.0493***	
	(0.186)	(0.131)	(0.120)		(0.00100)	
Sablefish	0.0154	-0.109	-0.114		-0.165***	
	(0.200)	(0.189)	(0.197)		(0.00144)	
Both				0.643***		-0.0990***
				(0.131)		(0.00334)
ITQxHalibut	-0.399*	-0.325*	-0.420***		-0.0751***	
	(0.204)	(0.184)	(0.150)		(0.00159)	
ITQxSablefish	-0.119	-0.218*	-0.211		-0.0499***	
	(0.158)	(0.129)	(0.141)		(0.00194)	
ITQxBoth				-0.178		-0.0580***
				(0.147)		(0.00325)
Observations	748	748	748	748	810	810
R-squared	0.106	0.816	0.847	0.694	0.964	0.719
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Port FE	No	Yes	Yes	Yes	Yes	Yes
Port Time Trend	No	No	Yes	No	Yes	No

Cluster robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6a: Regressions by processor city (1990-2000)

Variable	(1) Log Count	(2) Log Count	(3) Log Count	(4) Log Count
Halibut	0.193**	0.331***	0.336***	
	(0.0822)	(0.0797)	(0.0828)	
Sablefish	0.122**	0.131**	0.134**	
	(0.0525)	(0.0510)	(0.0528)	
Both				0.239***
				(0.0621)
ITQ x Halibut	-0.193***	-0.133**	-0.137**	
	(0.0694)	(0.0598)	(0.0593)	
ITQ x Sablefish	-0.180**	-0.172***	-0.174***	
	(0.0676)	(0.0621)	(0.0649)	
ITQ x Both				-0.151***
				(0.0565)
Observations	979	979	979	979
R-squared	0.010	0.781	0.816	0.764
Year FE	Yes	Yes	Yes	Yes
Port FE	No	Yes	Yes	Yes
Port Time Trend	No	No	Yes	No

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6b: Regressions by processor city (1990-2000)

	(5)	(6)	(7)	(8)
Variable	Log Revenue	Log Revenue	Log Revenue	Log Revenue
Halibut	1.213	2.577***	2.616***	
	(0.749)	(0.696)	(0.731)	
Sablefish	1.297	1.383	1.325	
	(0.788)	(0.830)	(0.855)	
Both				2.073***
				(0.736)
ITQ x Halibut	0.141	0.300	0.284	
	(0.570)	(0.496)	(0.534)	
ITQ x Sablefish	-0.139	0.0389	0.105	
	(0.560)	(0.519)	(0.556)	
ITQ x Both				0.128
				(0.471)
Observations	907	907	907	907
R-squared	0.034	0.584	0.620	0.558
Year FE	Yes	Yes	Yes	Yes
Port FE	No	Yes	Yes	Yes
Port Time Trend	No	No	Yes	No

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figures

Figure 1: Consolidation in halibut and sablefish harvesting

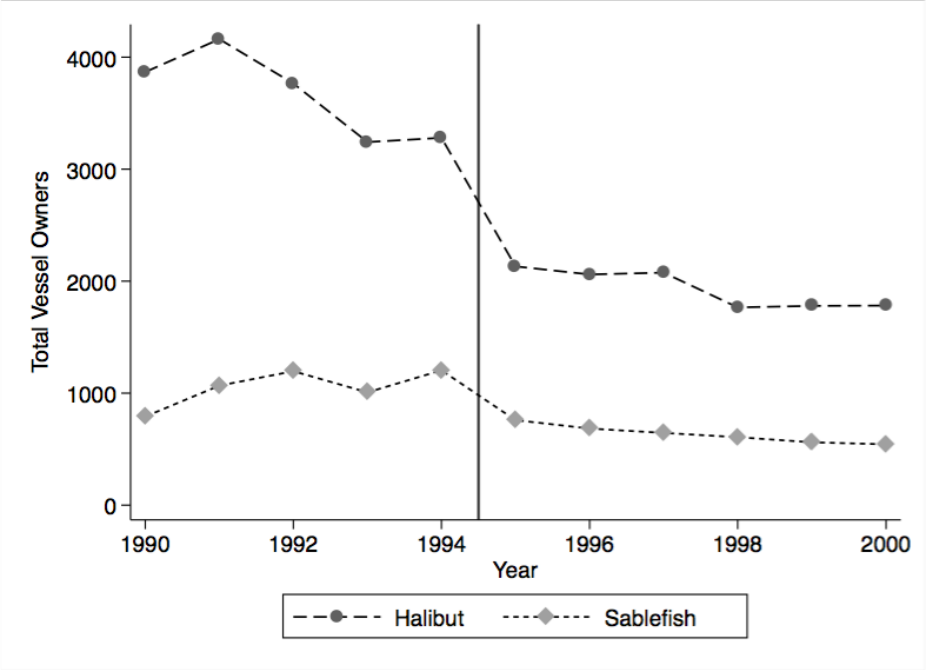


Figure 2: Ex-vessel revenue

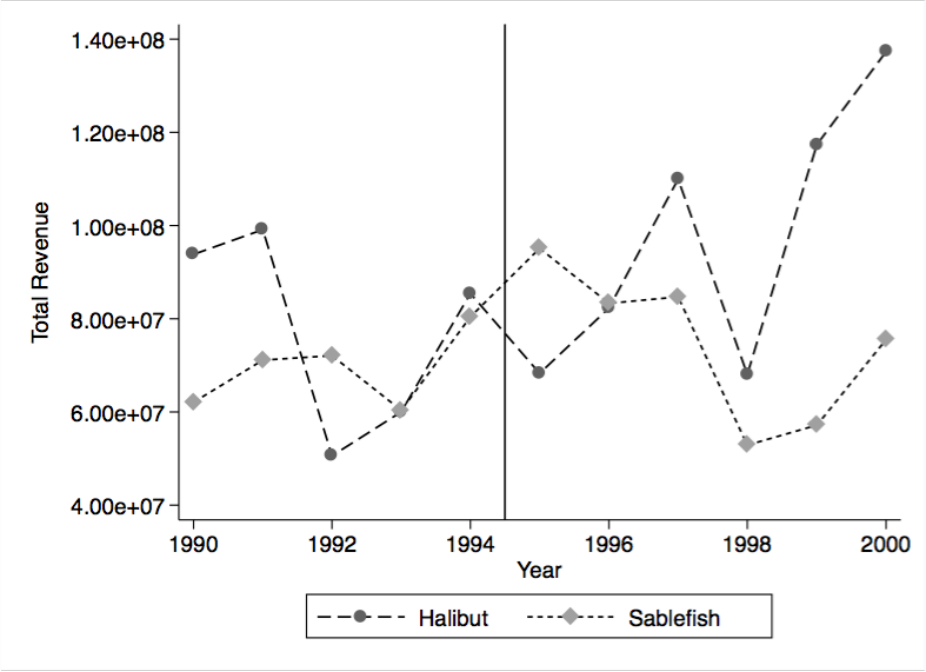


Figure 3: Mean revenue per harvester

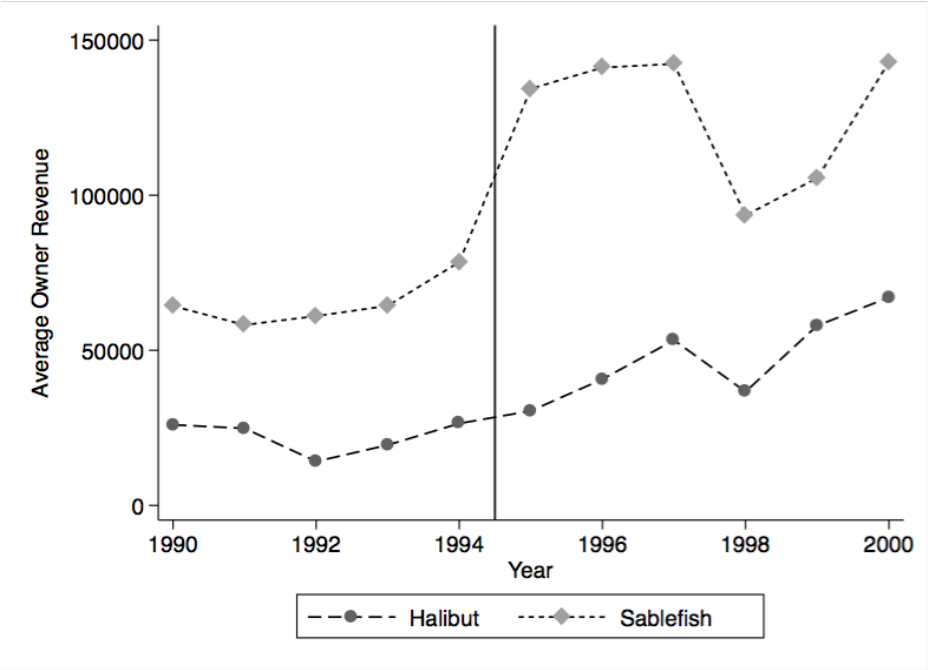


Figure 4: Home port deliveries

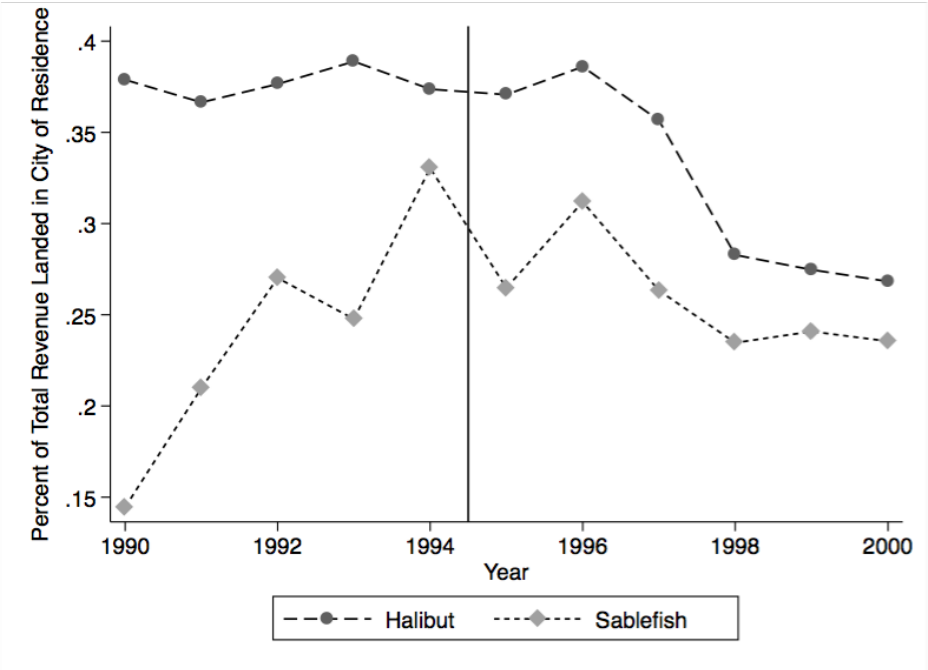


Figure 5: Consolidation in halibut and sablefish processing

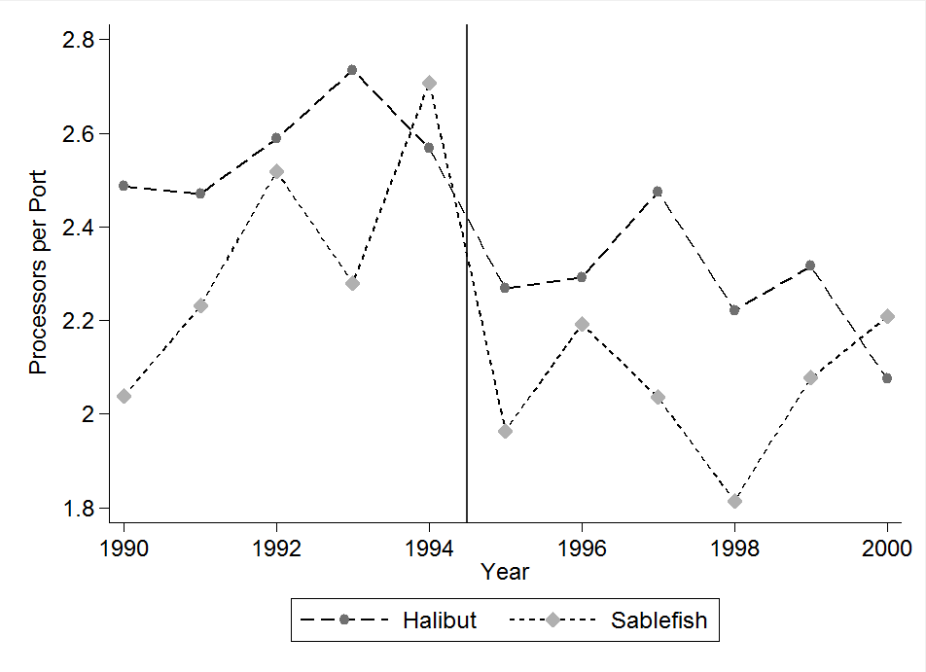
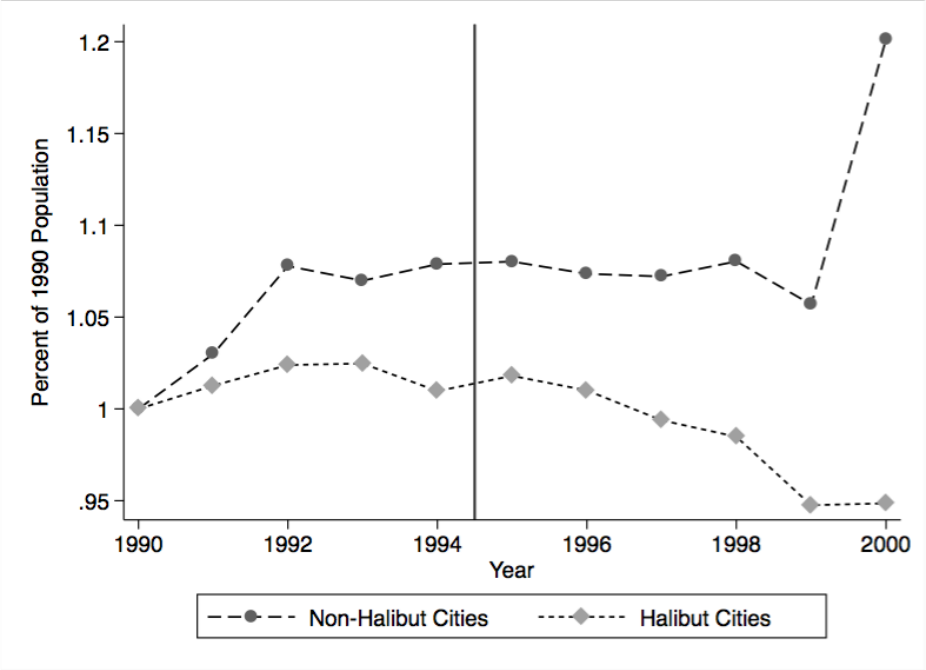


Figure 6: Mean proportion of 1990 population in cities under 500 people



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