Labor Supply of Fishermen: An Empirical Analysis

Tess Stafford*

October 2011

Draft

Abstract

When income effects are small, standard life-cycle models of labor supply predict a positive response in hours worked to increases in remuneration. However, several recent studies have found negative wage elasticities, casting doubt on the standard labor supply model. This paper aims to resolve some of this controversy by examining the responsiveness of the daily labor supply of fishermen to transitory variations in the wage using rich data from the Florida spiny lobster fishery. The data include complete records of all fishing trips made by Florida lobster fishermen over a twenty-year period and include two measures of effort - hours at sea and, when relevant, number of traps pulled - which makes it possible to look at the intensive labor supply margin in addition to the extensive margin. Results suggest that the wage elasticity of labor supply (participation) is positive and statistically different from zero, with a range of 1.05 to 1.31 for commercial trappers and 0.76 to 1.82 for commercial divers. Results also suggest that the wage elasticity of hours worked is positive and statistically different from zero, although quite small for trappers. Specifically, the elasticity ranges from 0.06 to 0.09 for trappers and 0.82 to 0.94 for divers. Although I do not specifically test a model of reference dependent preferences, these results support the standard neoclassical model of intertemporal substitution.

*Department of Economics, The University of New South Wales, Kensington NSW 2052, Australia. Email: t.stafford@unsw.edu.au. Home page: http://research.economics.unsw.edu.au/tstafford

1 Introduction

Does remuneration influence labor supply and, if so, to what extent? This is and has been a central question in labor economics. If an increase in remuneration is transitory, so that income effects are negligible, standard life-cycle models of labor supply predict an increase in labor supply. However, several recent studies have found large and statistically significant negative wage elasticities, casting doubt on the standard labor supply model. This paper aims to resolve some of this controversy by examining the responsiveness of the daily labor supply of fishermen to transitory variations in the wage using rich data from the Florida spiny lobster fishery.

In the 1980s, several studies attempted to estimate the intertemporal elasticity of substitution (IES) by relating annual changes in hours worked to annual changes in the average hourly wage, the hypothesis being that observed increases in the average hourly wage would induce an increase in annual hours worked.[1] Contrary to this hypothesis, the estimated elasticities are at best small, often statistically insignificant, and occasionally negative. However, annual wage changes are not likely to be purely transitory so that observed changes in the wage may be correlated with an unobserved change in expected lifetime wealth. In this case, estimates of the IES will be biased downward. Furthermore, it is likely that many of the individuals in the datasets used to estimate these elasticities are not fully capable of adjusting their hours worked in response to annual wage changes.[2] This feature of the data will also tend to bias estimates towards zero.

To address these concerns and attempt to improve on these estimates, a more recent and innovative literature has begun using data from industries that exhibit daily variation in both the wage and participation or hours worked.[3] The premise of these studies is that observed daily wage variation *is* transitory, so income effects can be ignored, and workers are autonomous, so they are able to respond to wage fluctuations. This emerging

[1] See, for example, MaCurdy (1981), Browning et al. (1985), and Altonji (1986).

[2] Many workers are compelled to work a fixed number of hours, such as a 40-hour work week.

[3] See, for example, Camerer et al. (1997), Oettinger (1999), Chou (2002), Treble (2003), Farber (2005), Fehr and Goette (2007), and Farber (2008).

literature utilizes data on workers from a variety of industries, including taxicab drivers, bike messengers, and baseball stadium vendors. Unfortunately, this literature also derives a variety of labor supply elasticity estimates ranging from -1 (Camerer et al. 1997) to 1.25 (Fehr and Goette 2007). Instead of narrowing the consensus regarding the sign and magnitude of the IES, these studies have sparked a new line of literature that is questioning the relevance of the standard neoclassical model of labor supply.

One alternative theory of labor supply that has been put forth suggests that workers have reference-dependent preferences where the reference is a daily income target. If the worker quits before this target is reached, the worker experiences an unpleasant feeling of "loss". Furthermore, workers are more sensitive to these "losses" than to "gains", which occur when daily income exceeds the target. A prediction stemming from such preferences is a negative elasticity of hours worked with respect to earnings per hour, a result that several studies have now obtained. This theory of reference-dependent preferences is by no means widely accepted, but it is gaining popularity among economists.

This paper aims to build on this literature by utilizing a rather large and unique data set on Florida lobster fishermen. The data include complete records of all fishing trips made by Florida lobster fishermen over a twenty-year period, which allows me to estimate the wage elasticity at the extensive margin. In addition to a participation decision, fishermen also decide on a daily hours or effort level. This is recorded in the data set by the number of hours out at sea and, when relevant, by the number of traps pulled. These measures provide the opportunity to estimate the wage elasticity at the intensive margin, which Oettinger (1999) is unable to do. Given the nature of fishing, exogenous, but predictable, wage variation exists through variation in the moon cycle and past weather conditions. These instruments are independent of aggregate labor supply and should not affect current opportunities outside of fishing or preferences for fishing, which is an improvement over the analyses in Camerer et al.

I separate the sample into commercial fishermen that use traps to harvest lobster and those that dive. In virtually every specification, for both trappers and divers, and for both margins of labor supply, elasticities are positive and statistically significant. More specifically, I find that the wage elasticity of hours worked ranges from 0.06 to 0.09 for trappers and 0.82 to 0.94 for divers and that the wage elasticity of participation ranges from 1.05 to 1.31 for trappers and 0.76 to 1.82 for divers. These estimates are consistent with intertemporal substitution and are in contrast to the findings of Camerer, et al. (1997) and Chou (2002). In this context, they do not support the notion of reference-dependent preferences (or income targeting) as put forth by these authors.

The next section provides a historical overview of the Florida spiny lobster fishery. Description of the data and the criteria used to determine the relevant population is discussed in Section 3. Section 4 presents the empirical model and Section 5 discusses the estimation strategy used to derive the wage elasticities. Empirical results are presented in Section 6. Section 7 concludes.

2 Description of the Florida Spiny Lobster Fishery

Commonly referred to as the Florida spiny lobster, panulirus argus is a warm-water clawless lobster found in the western Atlantic waters from North Carolina to Brazil.[4] In the United States, spiny lobster are primarily harvested in Floridas southernmost counties, Monroe and Dade, both in Atlantic waters and the Gulf of Mexico. This industry constitutes one of Florida's most important commercial fisheries with an average annual value in excess of 30 million U.S. dollars.

The fishery consists of a recreational sector and a commercial sector of trappers, divers, and bully netters.[5] Commercial fishermen collect and sell live whole lobsters to fish houses, which are usually located at their homeport. Fish houses remove the lobster tails and sell

[4] Background information on this fishery is taken from Shivlani, et al., SEDAR 08 U.S. Stock Assessment Panel and the Florida Fish and Wildlife Conservation Commission: Division of Marine Fisheries Management.

[5] Bully netters harvest lobster with hand nets. This requires fishing in very shallow waters so that lobster are visible from the boat. Although this technique used to be popular, bully netters currently contribute less than one percent of annual commercial lobster landings.

only this portion to restaurants and distributors. The tail usually constitutes slightly more than a third of the total weight of a lobster. Over the last twenty years, total commercial landings in the state of Florida averaged approximately 6 million pounds per year. Recreational fishermen generally contribute another 1.5 million pounds each year.[6]

In this paper, I separately analyze the labor supply behavior of commercial trappers and divers since there are reasons to believe these types of fishermen behave differently. Trappers tend to be full-time workers, while divers are more of the recreational or supplemental income types. Consequently, trappers have historically accounted for approximately 90% of annual commercial lobster landings. Trappers also face an additional constraint when it comes to daily labor supply decisions: they can only fish in areas in which they have previously dropped traps so their participation and effort level choices are necessarily a function of past labor supply choices. Since within-trap lobster abundance generally increases with

[6]There are general restrictions that apply to the entire industry as well as sector-specific regulations. The carapace length of the lobster must be a minimum of three inches in length, a size reached at approximately two years of age. Harvesting females carrying eggs is prohibited regardless of size. Spawning occurs between March and August giving rise to a season closure from April 1 to August 5. However, to boost tourism, the recreational sector enjoys an additional two-day sport season that falls on the last consecutive Wednesday and Thursday in July. While commercial fishermen must wait until August 5 to harvest lobster, trappers may drop traps as early as August 1 to allow them to accumulate lobster before the start of the season.

In Monroe County, recreational fishermen must possess a valid saltwater products license and a crawfish stamp and are subject to a six lobster per person per day bag limit, or 24 lobster per boat, whichever is greater. Until recently, commercial divers needed only to hold a saltwater products license and to abide by a per day boat limit that was set high enough that the restriction was rarely binding.

Since the 1950s, the commercial trap fishery has been responsible for the bulk of annual landings and the number of traps in the fishery steadily increased over the next 40 years. In the early 1960s, the number of traps was estimated to be less than 100,000, which rose to approximately 250,000 by the mid-1970s and may have been as high as 900,000 by 1990. However, the increase in trapper's fishing effort out-paced the growth in annual landings and so catch per unit effort (CPUE) steadily decreased from 1970 to 1990.

At this time, the fishery came under heavy scrutiny by the Florida Fish and Wildlife Conservation Commission (FWC). Because the commercial trap sector dominated the industry and because problems other than decreased CPUE were associated with the increase in the number of traps fished, such as increased by-catch mortality rate, the FWC focused its restructuring of the fishery on this sector only. The FWCs solution was a transferable trap certificate program (TCP), which was implemented at the start of the 1993/94 fishing season. The goal of the program was to reduce the number of traps to 400,000, although research suggested that this would still be twice the level that would achieve economic efficiency.

Trappers were issued certificates based on the number of pounds landed the previous two out of three seasons. The program stipulated a blanket 10% reduction in the number of traps four different times between 1993 and 1999 bringing the number of traps down to approximately 550,000. In 2000, the guidelines were relaxed to passive reductions.[7] With the exception of the 1999 season, total commercial landings fell from approximately seven million pounds in 1994 to three million pounds in 2001. During the same period, trappers' percentage of commercial landings steadily fell from 95% to 85%. So that trappers were not further injured from a potentially flawed program, the TCP reductions were suspended in 2004. Since then, the FWC and both the recreational and commercial sectors have been in mediation with the intent to better regulate the industry and promote biological and economic efficiency.

time until a maximum trap capacity is reached, trappers neither want to prematurely pull traps nor leave them soaking too long. Their expected wage is, therefore, in part a function of the length of time since the last pull. Because of this dependence, trappers' labor supply decisions may be less responsive to other variables that influence the expected daily wage.

3 Data Description & Sample Selection

Since 1978, fish houses have been required to fill out trip tickets for each sale made. Records of these trip tickets are maintained by the FWC. An example is shown in Figure 1. Field 1 records the fisherman's unique license number, which is used to track fishermen throughout time. Field 4 records the trip date. Fields 7 and 13 provide possible measures of the hours and effort margins, respectively. Fields 17 - 22 list each species that is sold, including the quantity sold and the price paid.

The FWC provided me with all trip ticket records from the 1986/87 fishing season through the 2006/07 season for which *any* amount of lobster was recorded in Fields 17 - 22. From this set of trip tickets, the FWC compiled a list of fishing licenses (Field 1) and additionally provided any remaining trip tickets that matched on fishing license. As a result, the data constitute a complete complete panel of all fishing trips made in Florida between the 1986/87 and 2006/07 fishing seasons by fishermen that ever sold at least one pound of spiny lobster. So, for any fisherman in the sample, I observe each and every day they sold *any* species of marine life as well as the composition of species sold.

Although the data to which I have access spans from the 1986/87 fishing season to the 2006/07 season, many of the trip tickets in the earlier years did not record the price paid per pound. Table 1 shows the percentage of trip tickets that are missing lobster prices by fishing season. These numbers are quite large between the 1986/87 and 1995/96 seasons, climbing as high as 76%. However, in the period from 1996/97 to 2006/07, no more than 1.67% of trip tickets are missing prices. Because the daily wage is a function of the price, I restrict my analysis to begin in the 1996/97 season so that I do not have to rely on sparse records of prices to generate wages.

In order to determine the relevant sample, several terms must be defined: 1) what constitutes a lobster trip; 2) what constitutes a trapper or diver; and 3) what constitutes a lobster fisherman. Table 2 chronicles changes to the sample size as these terms are defined and applied to the current sample. The first column identifies the criteria that is applied to the sample, which are discussed in detail below. "Group" splits the sample into trappers and divers when relevant. "Fishers" counts the number of unique fishermen, "Fisher-Seasons" counts the number of unique fisherman-lobster season pairs, "Actual Trips" counts the number of observed lobster trips, and "Possible Trips" counts the number of open season days, regardless of participation, once the sample is augmented to include the entire season for each fisherman-lobster season pair observed.

Since I do not know which specie(s) was (were) targeted on a given day, I infer the intent of the fisherman based on observed catch. There are 251,560 trips made by fishermen on which some amount of lobster was sold.[8] The contribution of lobster to the total value of the trip varies.[9] On average, the sale of lobster constitutes 91% of the total value of a trip and 75% of all trips that record any amount of lobster consist solely of lobster. So, for the bulk of trips, inference about intent to fish for lobster seems clear. However, for several thousand other trips this distinction is less clear. Figure 2 displays a histogram of the contribution of lobster to the total value of the trip once trips consisting solely of lobster are removed. With the exception of a small spike near zero, the distribution is fairly flat until around 60% when it starts to increase sharply. For the purposes of this study, I classify a trip as a lobster trip if at least 50% of the total value of the trip is from lobster sales. This classification re-designates 7.6% (or approximately 19,300) of the trips in the sample as non-lobster trips. After dropping a couple hundred other trips due to inconsistencies with the fisherman's social security number or license, the total number of lobster trips in

[8]See Row 1 of Table 2.

[9]XXXXXX Discuss computation of values and imputation of prices

the sample is 232,089.[10]

Although the lobster season stretches from August 6th - March 15th, I restrict my baseline analysis to include only August 6th - October 14th of each lobster season.[11] The reason for this is to simplify identification when estimating the model, which will be discussed in greater detail in Section 5. Briefly, identification relies, in part, on identifying factors that affect the expected wage in the lobster fishery, but that do not affect opportunity costs. Since many factors that affect the wage in the lobster fishery also affect the wage in other fisheries (e.g. weather), which may describe a fisherman's outside opportunities, it is convenient to focus on a portion of the season during which these outside opportunities do not exist. There is very little fishing activity by lobster fishermen in other fisheries during the first 2.5 months of the lobster season (August 6th - October 14th). In addition, since catch rates are much higher in the beginning of the season, very few fishermen that intend to fish for lobster would wait until after the first 2.5 months to partake in the fishery. Therefore, it is unlikely that many true lobster fisherman are dropped from the sample due to this restriction.

As discussed above, the main methods of harvesting lobster are with traps and by diving. 84% of lobster trip tickets report the use of traps, 16% report diving, and 3% report some other kind of gear.[12] Of the 1,994 unique fishers in the current sample that make at least one lobster trip, 532 (828) never report using traps (diving) and 710 (529) always report using traps (diving). The remaining fishermen report a mix of gear use throughout their tenure in the sample. Figures 3 and 4 displays a histograms of the percentage of lobster trips reporting the usage of traps and diving, respectively, for each fisherman once those that always or never use the specified gear type are removed. Not surprisingly, the spikes are at either end of the distribution with few fishermen falling in the gray middle ground. I restrict each sample to include only fishermen that report using the specified gear type

[10]See Row 2 of Table 2.

[11]Refer to Row 3 of Table 2.

[12]Just over 3% of trip tickets in the sample report more than one gear type so that gear usage does not have to sum to 100%.

(traps or diving) to harvest lobster at least 90% of the time. This reduces the sample to 963 trappers and 650 divers.[13]

While the remaining fishermen have all made at least one trip in which lobster was the primary species sold, whether or not all of these fishermen should be considered lobster fishermen solely on this basis is left to be determined. This is an important distinction since I am assuming that fishing for lobster is a viable option for each fisherman in the sample on each day in the season and for all seasons observed. If a fisherman makes few lobster trips throughout the sample relative to other non-lobster trips, fishing for lobster may not regularly be in the fisherman's choice set. To better ensure that it is, I further reduce the sample based on absolute and relative participation in the lobster fishery. Determining relative participation is possible since I observe all trips made by each fisherman and not just lobster trips.

Of the remaining observations in each sample, I drop all fisher-lobster season pairs for which only one lobster trip was observed, leaving 4,975 unique fisher-lobster season pairs for trappers and 1,966 unique pairs for divers.[14] For many of these pairs (1,187 for trappers and 572 for divers), 100% of observed trips are lobster trips. For the remaining pairs, the composition of trips is a mix of lobster and non-lobster trips. Figures 5 and 6 display histograms of the percentage of total trips that are lobster trips and the percentage of total earnings contributed by lobster trips, respectively, by fishing season for trappers. Figures 7 and 8 present the same information for divers. These histograms make it clear that trappers observed to fish for lobster have a much higher lobster trip and lobster earnings composition than divers. As a baseline, I drop from each sample all fisher-fishing season pairs for which percent participation in the lobster fishery is below 5% or for which percent earnings from lobster trips is below 5%. This removes 15 trappers and 25 divers from each sample.[15] Finally, I remove fishermen that are observed to fish for lobster less than five times over the

[13]Refer to Rows 4 - 6 of Table 2.
[14]Refer to Rows 7 - 9 of Table 2.
[15]Refer to Rows 10 - 12 of Table 2.

entire sample period (eleven seasons). This results in a final sample of 794 (371) trappers (divers), 4,864 (1,770) fisher-lobster season pairs, 93,714 (16,946) observed lobster trips, and 340,480 (123,900) possible lobster trip opportunities.[16]

This final sample is used to estimate the wage elasticity of labor supply at the extensive margin (participation). Unfortunately, not all trip tickets record time out at sea and number of traps pulled (if relevant), which are the two effort measures I use to estimate the wage elasticity at the intensive margin. Therefore, when modeling the intensive margin, the sample is further reduced to include only trappers with complete records of both effort measures and only divers with complete records of time at sea, resulting in 191 unique trappers and 210 unique divers. Further details of this sample are presented in the last three rows of Table 2.

Tables 3 and 4 provided summary statistics of the fishermen in both final samples. The weighted averages weight each fisherman's statistics by the number of times he is observed in the data. In both tables, fisherman that participate more frequently make slightly more revenue per trip, which might reflect a premium for experience. Trappers make more per trip on average than divers. Trappers also have higher participation rates. The standard deviations for each variable are all quite high relative to their means indicating the diversity in participation and earnings of the fishermen in the sample.

Comparing statistics across the two tables provides an idea of how similar the fishermen in the smaller sample are with the fishermen in the full sample. Fishermen in the smaller sample are observed for fewer lobster seasons, which is reflected by smaller "Possible days at sea" in Table 4 for both trappers and divers. They also make less per trip and have lower participation rates. From these tables it appears that trappers, especially, in the smaller sample may not be representative of the typical trapper in the full sample.

[16] Refer to Rows 13 - 15 of Table 2.

4 Empirical Model

Following MaCurdy (1981), I estimate the Frisch (or λ-constant) life-cycle model using the following specification:

$$lnN_{it} = F_{ni} + \delta_n lnW_{it} + \mathbf{Z}_{it}\boldsymbol{\gamma}_n + \epsilon_{nit} \tag{1}$$

and

$$lnW_{it} = F_{wi} + \mathbf{X}_{it}\boldsymbol{\beta} + \alpha_{it} + \epsilon_{wit} \tag{2}$$

where N denotes either hours at sea or number of traps pulled and W denotes earnings per hour or earnings per trap, depending on the specification. In both equations, F is a fisherman-specific fixed effect, which captures unobserved components of wealth and ability. The random error terms, ϵ_{nit} and ϵ_{wit}, are assumed to be independent and identically distributed normal. Z includes individual- and time-varying opportunity cost shifters and X includes individual- and time-varying factors that affect earnings in the lobster fishery.

Specifically, the vector **Z** includes dummy variables for September and October (August is the omitted month), Saturday and Sunday, and a time trend (by season). These variables capture any systematic differences in opportunity costs across time that are common to all fishermen in the sample. Saturday and Sunday are also interacted with the fisherman's age to capture differences in weekend effects by age. **Z** also includes the monthly, seasonally-adjusted unemployment rate.[17] According to the model, fishermen are more like to participate in the lobster fishery when their reservation wage is low, which is somewhat proxied by the unemployment rate.

The vector **X** includes dummy variables for September and October and a time trend (by season). Lobster abundance is highest when the season first opens (August), generally monotonically decreasing as the season progresses. Weather is another important factor affecting the wage. High wind speed tends to reduce vessel speed and makes fishing less efficient. It also decreases visibility, which is important for divers. Particularly high winds

[17] Data on the unemployment rate is obtained from the Bureau of Labor Statistics.

may even make fishing dangerous. We would, therefore, expect high current wind speed to deter participation. However, rough water from high winds also tends to stir lobsters out of reefs and gets them moving across the ocean floor and into traps. In addition, rough water tends to shift traps around making it difficult to locate traps. The first effect suggests that catches may be greater following high wind speeds. The second suggests that trappers may be inclined to go out fishing following high wind speeds in order to locate traps that have shifted before they are permanently lost. For these reasons, we expect high *lagged* wind speed to encourage participation for those with traps.

Daily wind speed data is available through the National Oceanic and Atmospheric Administration's (NOAA) historical weather buoy database. I use data from ten weather buoys spanning the geography and timeline of the sample.[18] NOAA records weather conditions every hour and wind speed is measured in meters/second. To determine daily wind speed, hourly wind speed is averaged from midnight until noon of the fishing day. The rationale is that fishermen wake at 6 a.m. and base daily decisions on the previous six hours of observed weather conditions and the forecast for the next six. Lagged wind speed is calculated as a two-day lag of current wind speed.

A lobster's natural habitat is in reefs and other dark enclosed areas, which is why trapping is effective. During the new moon, lobster tend to emerge from their hideouts and relocate, while during the full moon they tend to remain in hiding. This results in greater lobster abundance in traps especially around the new moon. For this reason, $\mathbf{X}$ also includes an explanatory variable to capture the effect of the the moon cycle on participation. A value of 1 indicates a full moon and a value of 0 indicates a new moon. The variable also takes on 13 values in between 0 and 1 to capture daily stages of the moon cycle.

To determine whether or not to participate on a given day, I follow Kimmel and Kniesner (1998) and assume fishermen compare utility from participation, $U(N > 0)$, with utility from non-participation, $U(N = 0)$. If fisherman i is observed to participate in the lobster

[18] Archives of daily weather conditions can be found on NOAA's National Buoy Data Center website: http://www.ndbc.noaa.gov.

fishery on date t, then it is assumed that $U(N > 0) \geq U(N = 0)$. Therefore, the probability of participation, $P(participation_{it} = 1)$, is $P[U(N > 0) - U(N = 0)]_{it} = \Phi(\epsilon_{pit})$, where $\Phi(.)$ is the standard normal cdf and ϵ_{pit} is the combined random error component of $[U(N > 0) - U(N = 0)]$. When fishermen decide whether or not to participate, they do so by comparing earnings (the wage) with opportunity costs (the reservation wage). Therefore, the structural equations for the probability of participation and time at sea (or number of traps pulled) share the same explanatory variables. The structural participation equation is given by:

$$P(participation_{it} = 1) = \Phi(F_{pi} + \delta_p lnW_{it} + \mathbf{Z}_{it}\boldsymbol{\gamma}_p) \quad (3)$$

where the coefficients on the explanatory variables include the subscript p to distinguish them from the coefficients in equation (1).

The estimated coefficient on the wage in equation (1), $\hat{\delta}_n$, measures the Frisch wage elasticity of labor supply (or intertemporal substitution elasticity) at the intensive margin. The estimated elasticity of a wage change on the probability of participation, derived from equation (3), is given by $\hat{\delta}_p \phi(\hat{F}_{pi} + \hat{\delta}_p lnW_{it} + \mathbf{Z}_{it}\hat{\boldsymbol{\gamma}}_p)/\Phi(\hat{F}_{pi} + \hat{\delta}_p lnW_{it} + \mathbf{Z}_{it}\hat{\boldsymbol{\gamma}}_p)$, where ϕ denotes the standard normal pdf.

5 Estimation Strategy

Estimation proceeds in four steps, beginning with Heckman's two-step procedure to correct for possible selection bias. First, a reduced form probit model of participation is estimated in which $\mathbf{X}_{it}$, $\mathbf{Z}_{it}$, and a complete set of fisherman fixed effects are included as explanatory variables. The inverse Mills ratio is calculated from the reduced form probit coefficients to control for possible selection bias in the wage equation (2) and time at sea equation (1).

Second, I estimate a selectivity-corrected wage equation in which the inverse Mills ratio generated from step 1 is included as an additional explanatory variable in equation (2). Identification of the selection correction term (beyond relying on functional form differences) requires that some of the factors that affect participation do not affect the wage (i.e. components of **Z** that do not belong to **X**). I assume that Saturday and Sunday and interactions of these variables with the fisherman's age satisfy this requirement. An uncensored sample of the wage is constructed from the estimates of the selectivity-corrected wage equation, which allows for estimation of structural equations (1) and (3).

Third, a selectivity-corrected time at sea equation is estimated using the predicted wage from step 2 and including the inverse Mills ratio generated from step 1 as an additional explanatory variable. This produces an estimate of the Frisch elasticity of labor supply. The model is identified if some of the factors that affect the wage do not affect participation, except through the wage (i.e. components of **X** that do not belong to **Z**). I assume that lagged wind speed and the moon cycle satisfy this requirement.[19]

Finally, I estimate a structural probit model of participation (equation 3) using the predicted wage from step 2, which estimates the elasticity of a wage change on the probability of participating. Identification is achieved under the same requirements and assumptions as step 3.

6 Empirical Results

Empirical results of several specifications are shown in Tables 5 - 16. I estimate models using three different definitions for the wage: 1) wage = daily earnings/hours at sea, 2) wage = daily earnings/number of traps pulled, and 3) wage = daily earnings, where daily earnings is defined as the product of the offered price per pound and number of pounds landed. I also estimate models using different criteria to determine the effective sample of fishermen. Each Table presents results for both trappers and divers, when relevant. In Tables 5 - 14, robust standard errors and z-statistics are presented alongside point estimates. In Tables 15 and 16, robust standard errors are presented below point estimates and statistical significance at the 1% level is denoted by three asterisks, the 5% level by two asterisks, and the 10%

[19] During the period of August 6th - October 14th, the stone crab, kingfish, and reef fish fisheries (fisheries that lobster fishermen commonly participate in) are very inactive if not entirely closed. Therefore, lobster fishermen's outside opportunities can be assumed to consist of non-fishery alternatives so that lagged wind speed and the moon cycle are reasonably excluded from $\mathbf{Z}_{it}$.

level by one asterisk. The total number of observations as well as the number of unique fishermen in each sample is presented at the bottom of each table. Fisherman fixed effects are included in all specifications, but are not displayed in the tables.

6.1 Hours at Sea

Tables 5 - 8 display results of each estimation step where the wage is defined as daily earnings divided by hours at sea. Table 5 presents estimates from the reduced form probit model of participation. For both trappers and divers, the coefficients on September and October are negative and the coefficient on October is larger in magnitude. This reflects the tendency for lobster abundance to decrease as the season progresses. The days of week and interactions with age produce mixed results across the two fisher groups. The average trapper's age in the sample is 52. The combined marginal effect of Saturday on the probability of participating is essentially 0 for trappers of age 52. This effect becomes increasingly negative as fishermen get older at a rate of -.17% per year of age. The opposite relationship is true for divers. While the combined marginal effect of Saturday on the probability of participating is also essentially 0 for divers of age 52, the probability of participating increases slightly with age at a rate of .05% per year.[20] For both fisher types, Sunday is a strong deterrent of participation. Trappers of age 52 are 8.5% less likely to participate on a Sunday and this effect increases in magnitude at a rate of .12% per year of age. Divers of the same age are 2.6% less likely to participate on a Sunday. Although this negative effect becomes smaller with age, it does so at a very slow rate (+.05% per year).

Trappers are more likely to participate when the unemployment rate is high, although this effect is not statistically significant. However, divers are actually less likely to participate, which is counterintuitive. High wind speed deters both fisher types from participating. As anticipated, lagged wind speed increases the probability of participation for trappers. The converse is true for divers which may be due to decreased visibility after high winds. Trappers are more likely to fish during the new moon. The same is true for divers, although

[20] The average age of divers in the sample is 44.

the effect is not significant. For both groups, the coefficient on the time trend indicates an overall decrease in participation throughout the sample.

Table 6 presents estimates of the selectivity-corrected log earnings equation. As seen by the coefficients on September and October, the wage decreases as the season progresses. Wind speed negatively affects the wage, but the effect is much stronger and more significant for divers. For trappers, the wage is higher two days after high winds, but for divers, it is lower. The negative coefficients on the two weather variables for divers again likely reflects the decrease in visibility associated with high winds. As anticipated, the moon cycle has a strong effect on the wage for trappers and no effect on that for divers. There is a very slightly negative trend in the wage as indicated by the coefficient on the time trend. Finally, the positive coefficient on the inverse Mills ratio (although insignificant for trappers) provides some evidence of positive selection. The selection term is identified through the exclusion of the day of week variables from the wage equation, which were statistically significant, for the most part, in the reduced form participation model.

Results from the selectivity-corrected hours at sea equation are shown in Table 7. Of foremost importance is the coefficient on the predicted wage, which measures the wage elasticity of hours worked. While it is positive and just statistically significant for trappers, it is quite small, suggesting that trappers do not vary their hours at sea much in response to changes in the wage. In fact, hours are not affected by many of the covariates in the model. The coefficient on the predicted wage for divers, on the other hand, is much larger and more significant suggesting that a 1% increase in the daily wage leads to a .93% increase in hours at sea, which translate, on average, to a $10 increase in the wage producing a 1 hour increase in hours spent at sea.[21]

The large difference in the wage elasticity across fisher groups, as well as the discrepancies between the magnitudes and significance levels of the other covariates, may be due to the following. The ocean is a very patchy environment such that lobster abundance tends to

[21] Whereas for trappers, a $10 increase in the wage would, on average, lead to a 3 minute increase in time spent at sea.

vary from area to area. Trappers drop groups of traps in different areas where they expect catch rates to be high. When trappers decide to participate in the lobster fishery on a given day, they do so with a fishing location in mind where they have previously dropped traps. Because of the way traps are dropped in lines, pulled, and re-dropped, trappers are very unlikely to only pull a portion of a line once they have started. In addition, because trap lines are grouped in different areas, trappers tend to pull all of the lines in each group on a rotational basis so that once they have decided to visit a particular area, they are much more likely to pull all traps in the area regardless of the revealed catch rate. If catch rates are particularly bad, trappers may even decide to move these traps to another area, which results in high hours on low wage days. On the flip side, trappers may not be able to work more hours on high wage days if they have pulled all of their traps in one area and it would take too long to visit another location and pull all of the lines in that area.[22] Finally, fish houses close in the evenings so that there is essentially a cap on the number of hours one can work in a day. Divers, on the other hand, are not constrained to fish in locations where they have previously set traps. They have little overhead and may visit reefs where they can easily quit after an hour of fishing if it is unproductive. However, they, too, are subject to the fact that fish houses close in the evenings and the setting sun greatly decreases visibility.

Finally, Table 8 displays results from the structural probit model of participation. The coefficients on the predicted wage for both fisher groups are positive and highly significant. Two forms of the wage elasticities are calculated and are shown below the coefficients. The first elasticity is evaluated at the sample means of the covariates and the second is the sample mean of the estimated elasticity for each fisherman.[23] The wage elasticity is approximately 1.3 for trappers and 1.15 for divers suggesting that fishermen's labor supply, in terms of participation, is quite responsive to changes in the daily wage. Overall, these estimates support the neo-classical model of labor supply. They are in contrast to the

[22] Most fishermen are not equipped to fish for more than one day because lobster need to be kept live or on ice.

[23] I still need to calculate standard errors for the second elasticity.

findings of Camerer, et al. (1997) and Chou (2002) and do not support the notion of reference-dependent preferences (or income targeting) as put forth by these authors.

6.2 Number of Traps Pulled

Tables 9 - 10 present results for steps 3 and 4 when the wage is defined as daily earnings divided by the number of traps pulled. These tables therefore only present results for trappers. Both elasticities are almost identical across specifications.

6.3 Daily Earnings

Tables 11 and 14 present results of the structural probit model of participation (step 4) when the wage is simply defined as daily earnings. The results in Table 11 are based on the smaller samples used in estimations described in the previous two sections. The results in Table 14 are based on the full sample, which is described in detail in Section 3. The full sample can be used in this specification because measures of time at sea and traps pulled are not necessary to calculate the daily wage. Comparing Table 8 with Table 11, the wage elasticity for trappers remains the same regardless of the definition of the wage. However, the elasticity for divers drops about .4%. Tables 11 and 14 present estimates from the same model, but with different samples. When the full sample is used, the elasticities remain positive and highly significant, however it shrinks slightly for trappers and more than double for divers. This suggests that those fishermen with complete records of hours at sea are not necessarily randomly selected from the entire population.

6.4 Sample Selection Criteria Tests

Tables 15 and 16 show results for steps 3 and 4, respectively, using three different criteria to define the effect sample. In both tables and for both trappers and divers, Sample 2 refers to the baseline sample described in Section 3 and used to estimate the models in Section 6.1. Sample 1 relaxes the criteria to include fishing seasons in which fishermen made one or more lobster trips, fishing seasons in which at least 1% of all trips taken were lobster trips and 1% of earnings came from lobster sales, and fishermen that made two or more lobster trips over the entire time they are observed. Sample 3, tightens that criteria to include only fishing seasons in which fishermen made five or more lobster trips, fishing seasons in which at least 15% of all trips taken were lobster trips and 15% of earnings came from lobster sales, and fishermen that made ten or more lobster trips over the entire time they are observed. For the most part, the results are qualitatively the same across all three samples and the estimated wage elasticities remain positive, statistically significant, and around the same magnitude.

7 Conclusion

This paper estimates the wage elasticity of labor supply at both the intensive and extensive margin using data from the Florida spiny lobster fishery. I separate the sample into commercial fishermen that use traps to harvest lobster and those that dive. In virtually every specification, for both trappers and divers, and for both margins of labor supply, elasticities are positive and statistically significant. More specifically, I find that the wage elasticity of hours worked ranges from 0.06 to 0.09 for trappers and 0.82 to 0.94 for divers and that the wage elasticity of participation ranges from 1.05 to 1.31 for trappers and 0.76 to 1.82 for divers. These estimates support the neo-classical model of labor supply and are in contrast to the findings of Camerer, et al. (1997) and Chou (2002). In this context, they do not support the notion of reference-dependent preferences (or income targeting) as put forth by these authors.

References

[1] Altonji, J. 1986. "Intertemporal Substitution in Labor Supply Evidence from Micro Data." *The Journal of Political Economy*, 94(3): 176-215.

[2] Browning, M., Deaton, A., and Irish, M. 1985. "A Profitable Approach to Labor Supply and Commodity Demands Over the Life-Cycle." *Econometrica*, 53(3): 503-43.

[3] Camerer, C., Babcock, L., Loewenstein, G., and Thaler, R. 1997. "Labor Supply of New York City Cabdrivers: One Day at a Time." *The Quarterly Journal of Economics*, 112(2): 407-41.

[4] Chou, Y. 2002. "Testing Alternative Models of Labour Supply: Evidence from Taxi Drivers in Singapore." *The Singapore Economic Review*, 47(1): 17-47.

[5] Farber, H. 2005. "Is Tomorrow Another Day? The Labor Supply of New York City Cabdrivers." *Journal of Political Economy*, 113(1): 46-82.

[6] Farber, H. 2008. "Reference-Dependent Preferences and Labor Supply: The Case of New York City Taxi Drivers." *American Economic Review*, 98(3): 1069-82.

[7] Fehr, E., and Goette, L. 2007. "Do Workers Work More if Wages Are High? Evidence from a Randomized Field Experiment." *American Economic Review*, 97(1): 298-317.

[8] Gautam, A., Strand, I., and Kirkley, J. 1996. "Leisure/Labor Tradeoffs: The Backward-Bending Labor Supply in Fisheries." *Journal of Environmental Economics and Management*, 31(3): 352-67.

[9] MaCurdy, T. 1981. "An Empirical Model of Labor Supply in a Life-Cycle Setting." *The Journal of Political Economy*, 89(6):1059-85.

[10] Oettinger, G. 1999. "An Empirical Analysis of the Daily Labor Supply of Stadium Vendors." *The Journal of Political Economy*, 107(2): 360-92.

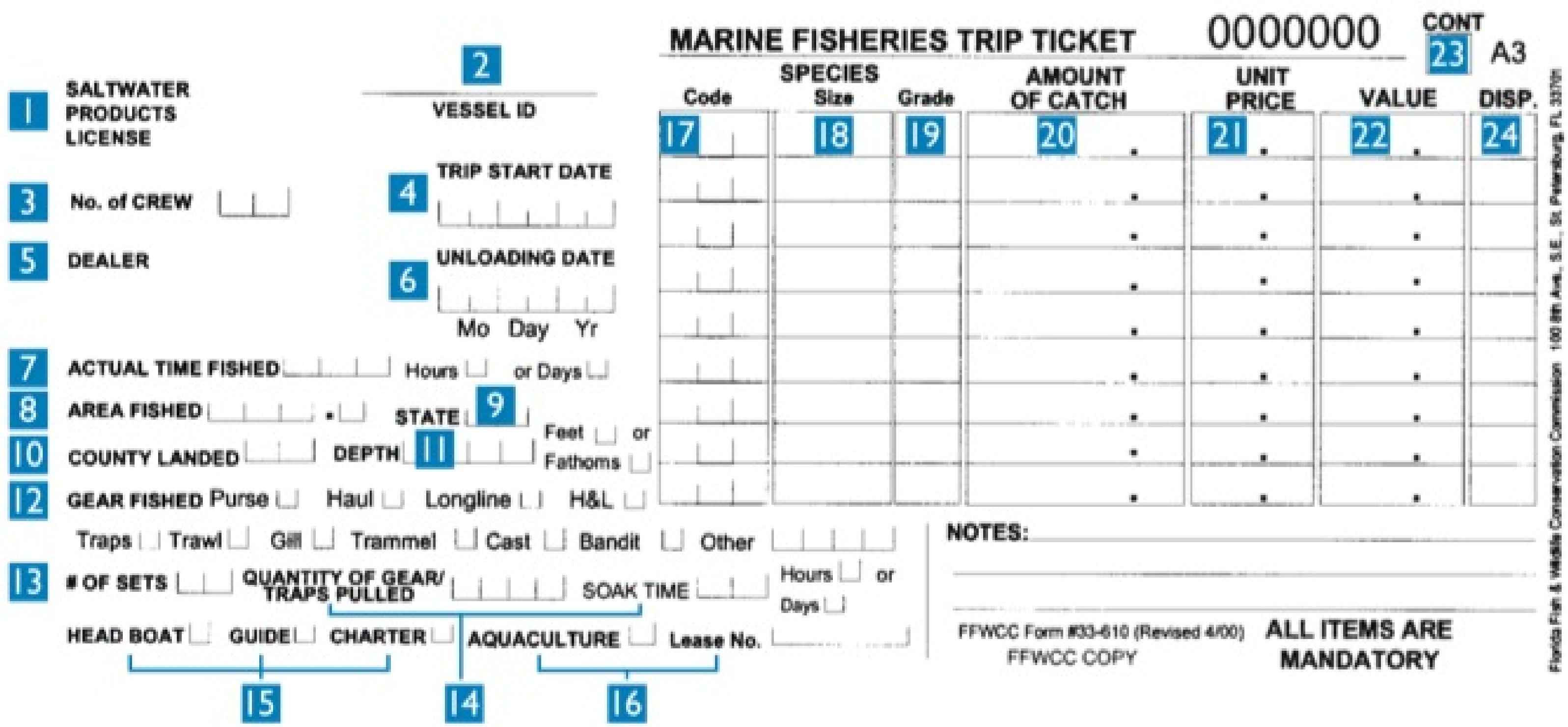
[11] Trebble, J. 2003. "Intertemporal Substitution of Effort: Some Empirical Evidence. *Economica*, 70: 579-95.

[12] Weitzman, M. 2002. "Landing Fees vs. Harvest Quotas with Uncertain Fish Stocks." *Journal of Environmental Economics and Management*, 43(2): 325-38.

[13] Weitzman, M. 1974. "Prices vs. Quantities." *The Review of Economic Studies*, 41(4): 477-91.

Table 1: Percentage of Trip Tickets Missing Prices by Fishing Season

Season	% Missing Prices	Season	% Missing Prices
1986	73.36	1996	1.67
1987	76.18	1997	1.38
1988	67.14	1998	0.66
1989	71.63	1999	0.15
1990	58.74	2000	0.00
1991	61.97	2001	0.00
1992	66.35	2002	0.30
1993	56.47	2003	0.22
1994	46.60	2004	1.51
1995	12.69	2005	0.15
		2006	0.09
		2007	0.08



MARINE FISHERIES TRIP TICKET 0000000 CONT 23 A3

1 SALTWATER PRODUCTS LICENSE

2 VESSEL ID

3 No. of CREW

4 TRIP START DATE

5 DEALER

6 UNLOADING DATE

Mo Day Yr

7 ACTUAL TIME FISHED Hours or Days

8 AREA FISHED . STATE 9

10 COUNTY LANDED DEPTH 11 Feet or Fathoms

12 GEAR FISHED Purse Haul Longline H&L

Traps Trawl Gill Trammel Cast Bandit Other

13 # OF SETS QUANTITY OF GEAR/ TRAPS PULLED SOAK TIME Hours or Days

HEAD BOAT GUIDE CHARTER AQUACULTURE Lease No.

15 14 16

SPECIES Code	Size	Grade	AMOUNT OF CATCH	UNIT PRICE	VALUE	DISP.
17	18	19	20 .	21 .	22 .	24
			.	.	.	
			.	.	.	
			.	.	.	
			.	.	.	
			.	.	.	
			.	.	.	
			.	.	.	
			.	.	.	

NOTES:

FFWCC Form #33-610 (Revised 4/00)
FFWCC COPY

ALL ITEMS ARE MANDATORY

Florida Fish & Wildlife Conservation Commission 100 8th Ave., S.E., St. Petersburg, FL 33701

Figure 1: Florida Fish and Wildlife Conservation Commission Marine Fisheries Trip Ticket

Table 2: Sample Details

Variable	Group	Fishers	Fisher-Seasons	Actual Trips	Possible Trips
All Lobster Trips	All	2,423	10,971	251,560	-
Primary Lobster Trips	All	2,249	10,433	232,089	-
Beginning of Season	All	1,994	9,423	125,303	659,610
90%+ Traps/Dive	All	1,613	7,822	112,437	547,540
	Trappers	963	5,302	94,378	371,140
	Divers	650	2,520	18,059	176,400
1+ Lobster Trips (Yr)	All	1,355	6,941	111,556	485,870
	Trappers	868	4,975	94,051	348,250
	Divers	487	1,966	17,505	137,620
5%+ Rev & Trips from Lobster (Yr)	All	1,315	6,790	111,073	475,300
	Trappers	853	4,925	93,884	344,750
	Divers	462	1,865	17,189	130,550
5+ Lobster Trips (All Yrs)	All	1,165	6,634	110,660	464,380
	Trappers	794	4,864	93,714	340,480
	Divers	371	1,770	16,946	123,900
Effort Measure(s) Recorded	All	562	2,462	26,313	172,340
	Trappers	191	692	9,367	48,440
	Divers	210	869	6,688	60,830

of Lob Value to Total Value.pdf

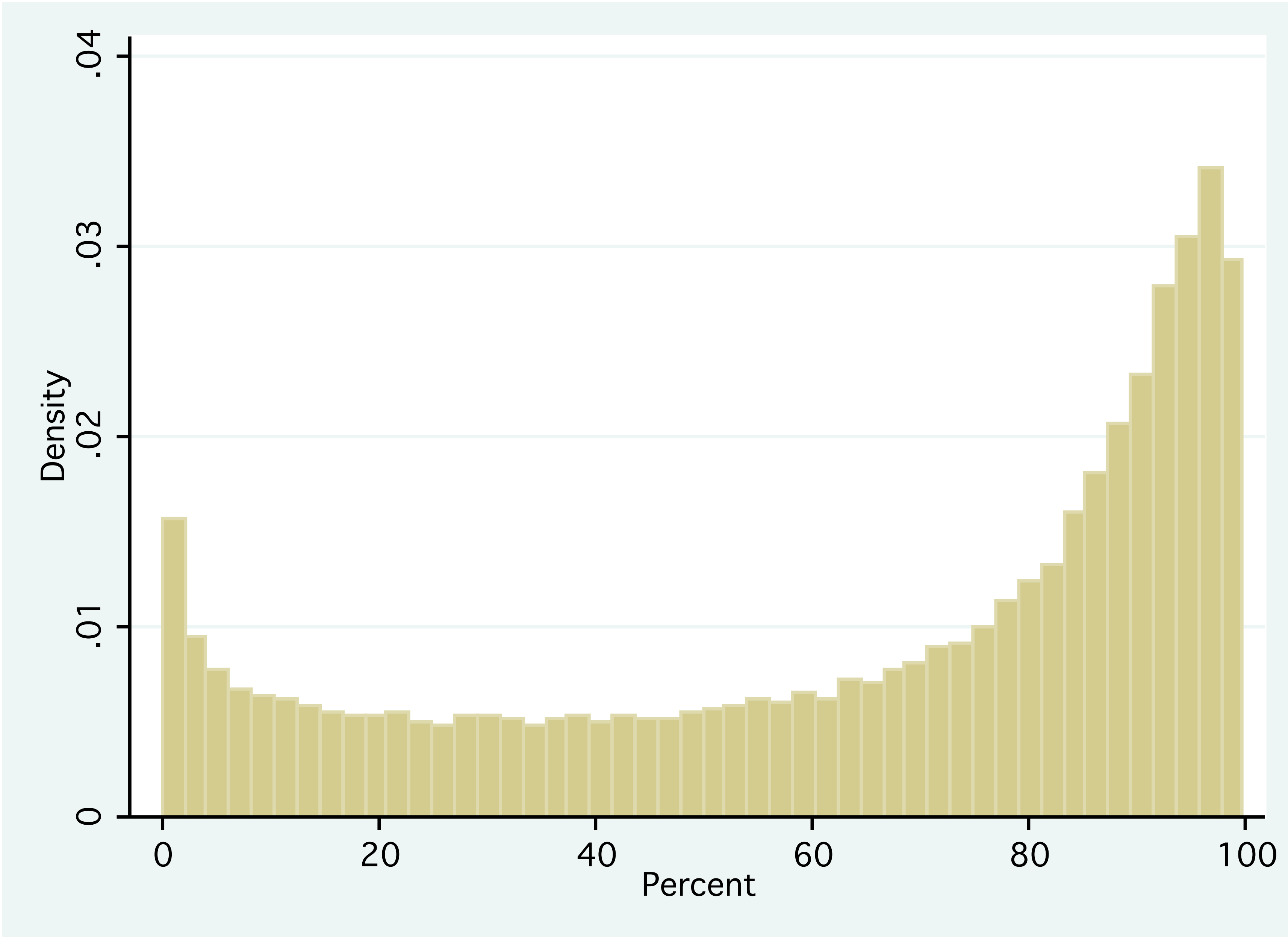


Figure 2: Histogram of the Contribution of Lobster to the Total Value of the Trip Once Trips Consisting Solely of Lobster are Removed

of Lobster Trips Reporting Trap Usage.pdf

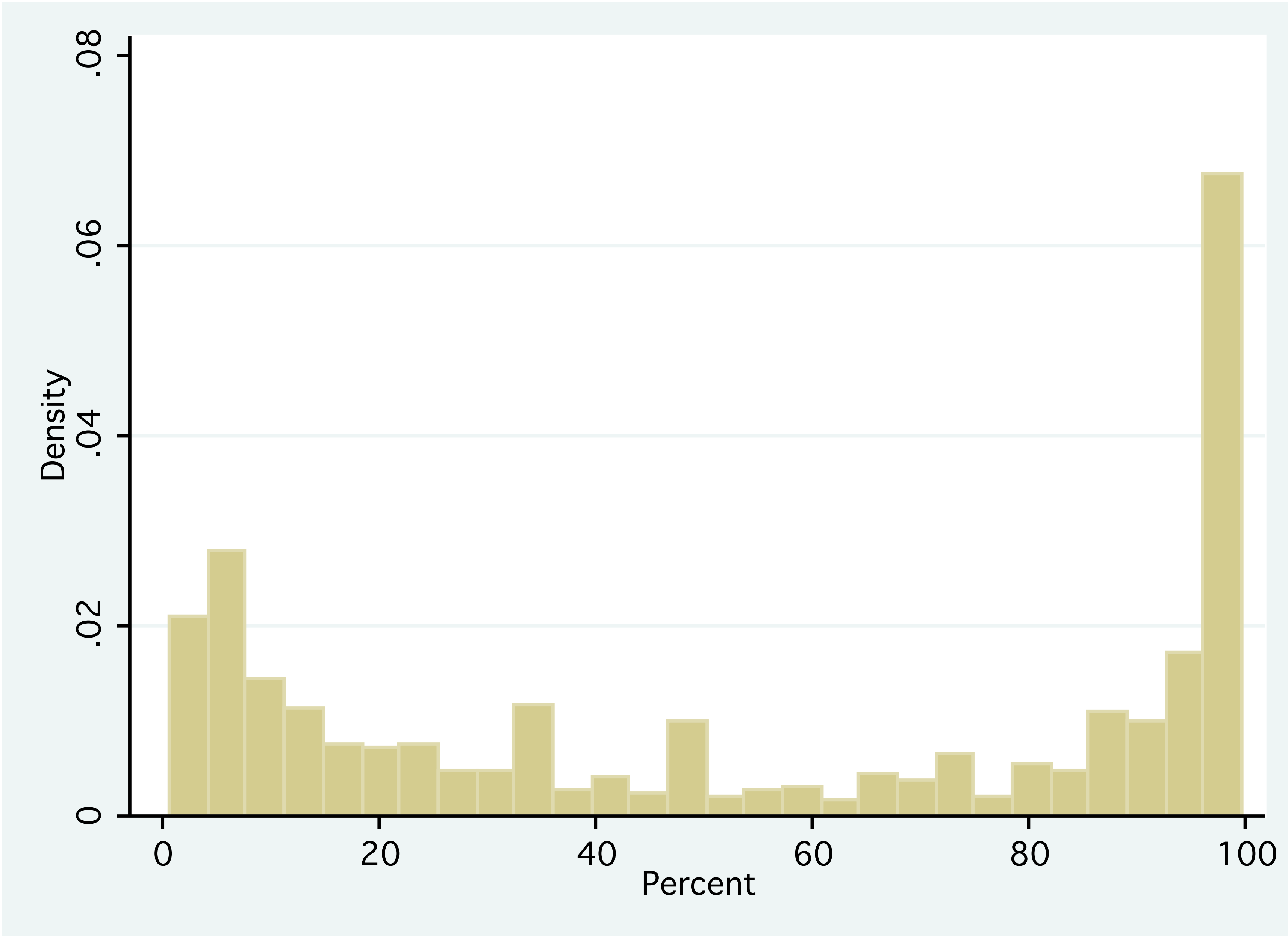


Figure 3: Percentage of Lobster Trips Reporting Trap Usage

of Lobster Trips Reporting Diving.pdf

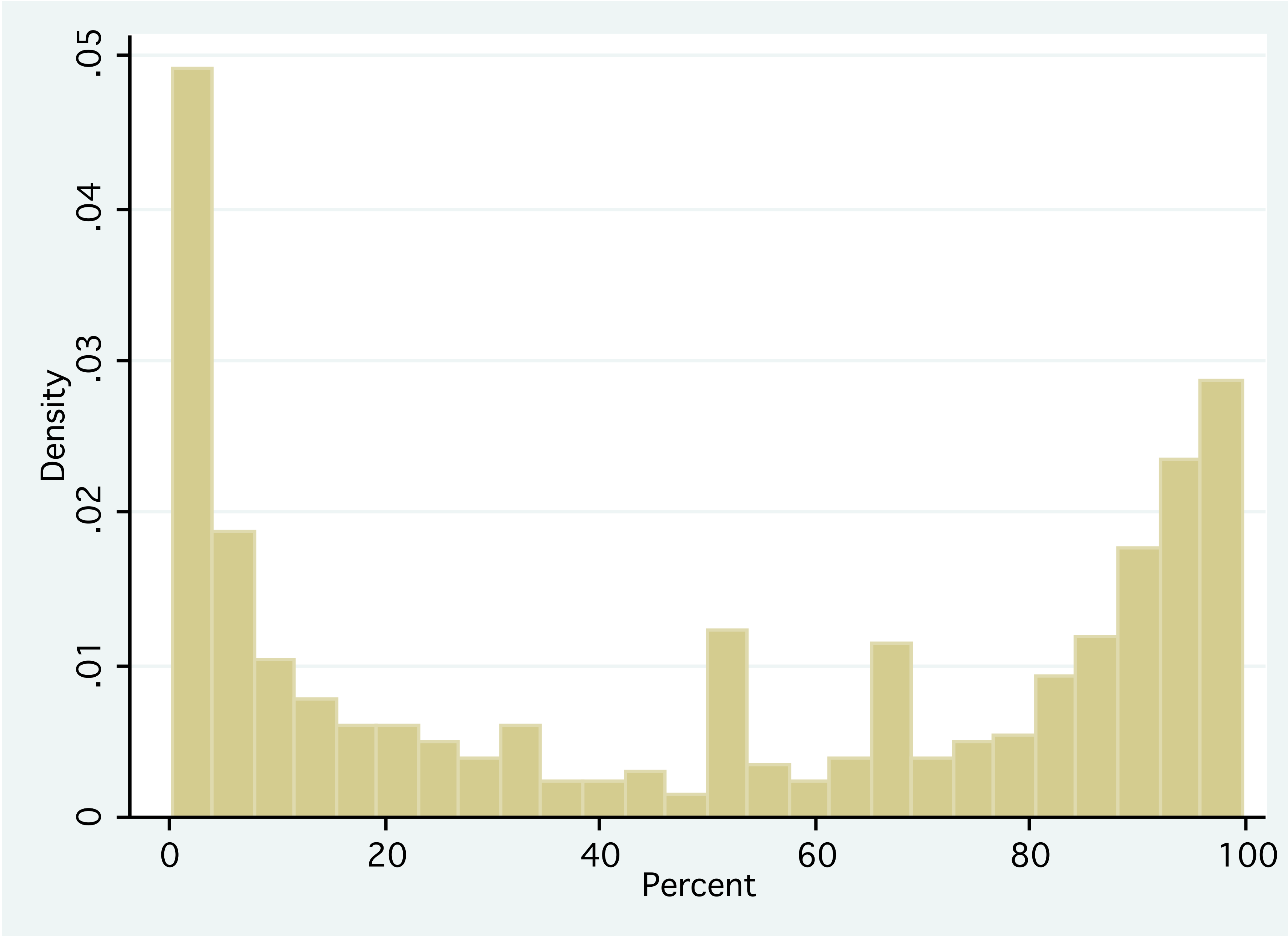


Figure 4: Percentage of Lobster Trips Reporting Diving

of Lob Trips by Fisher-Fishyear - traps.pdf

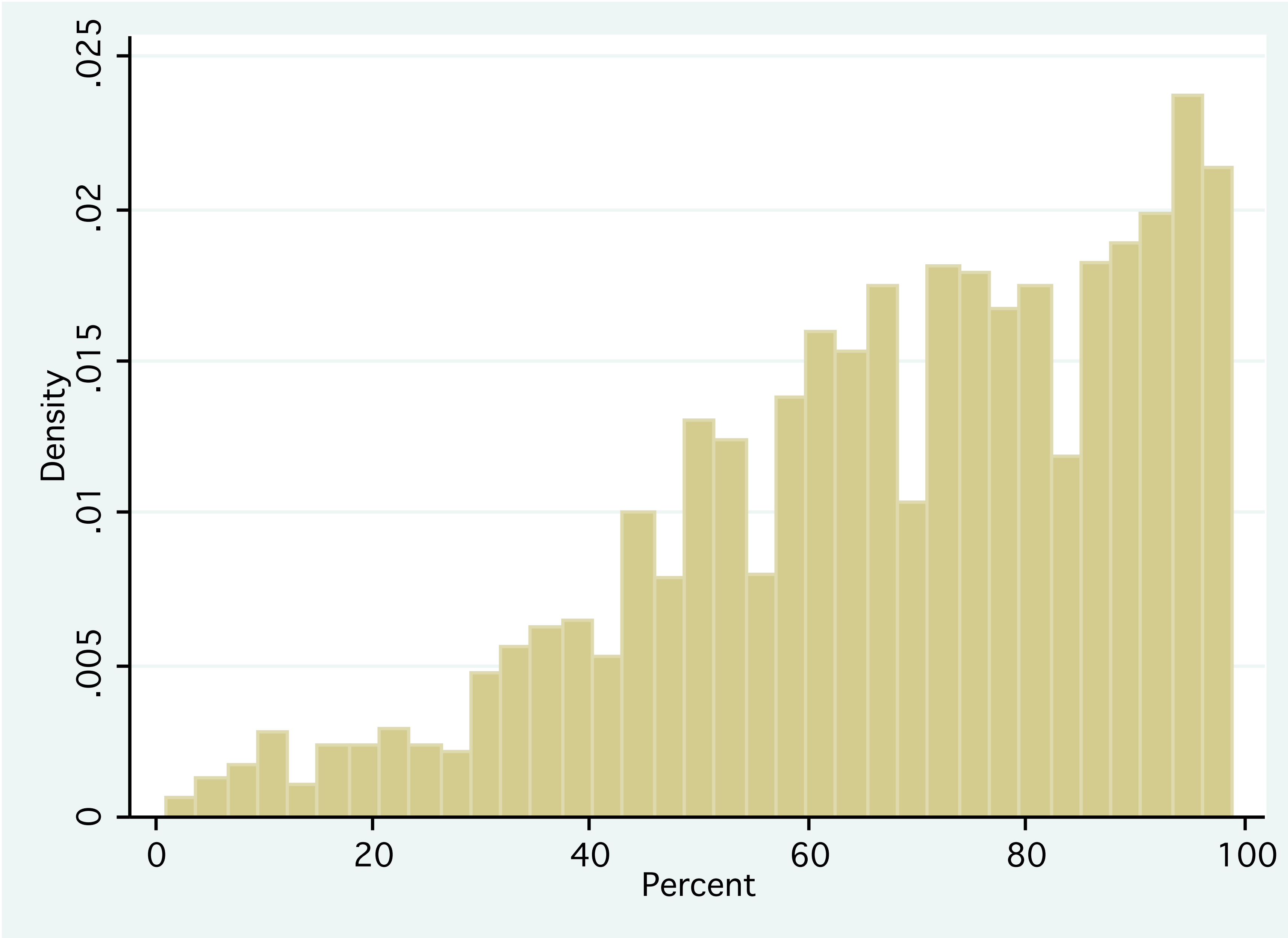


Figure 5: Percentage of Total Trips that are Lobster Trips by Fisher-Fishing Season - Trappers

of Earnings from Lob Trips by Fisher-Fishyear - traps.pdf

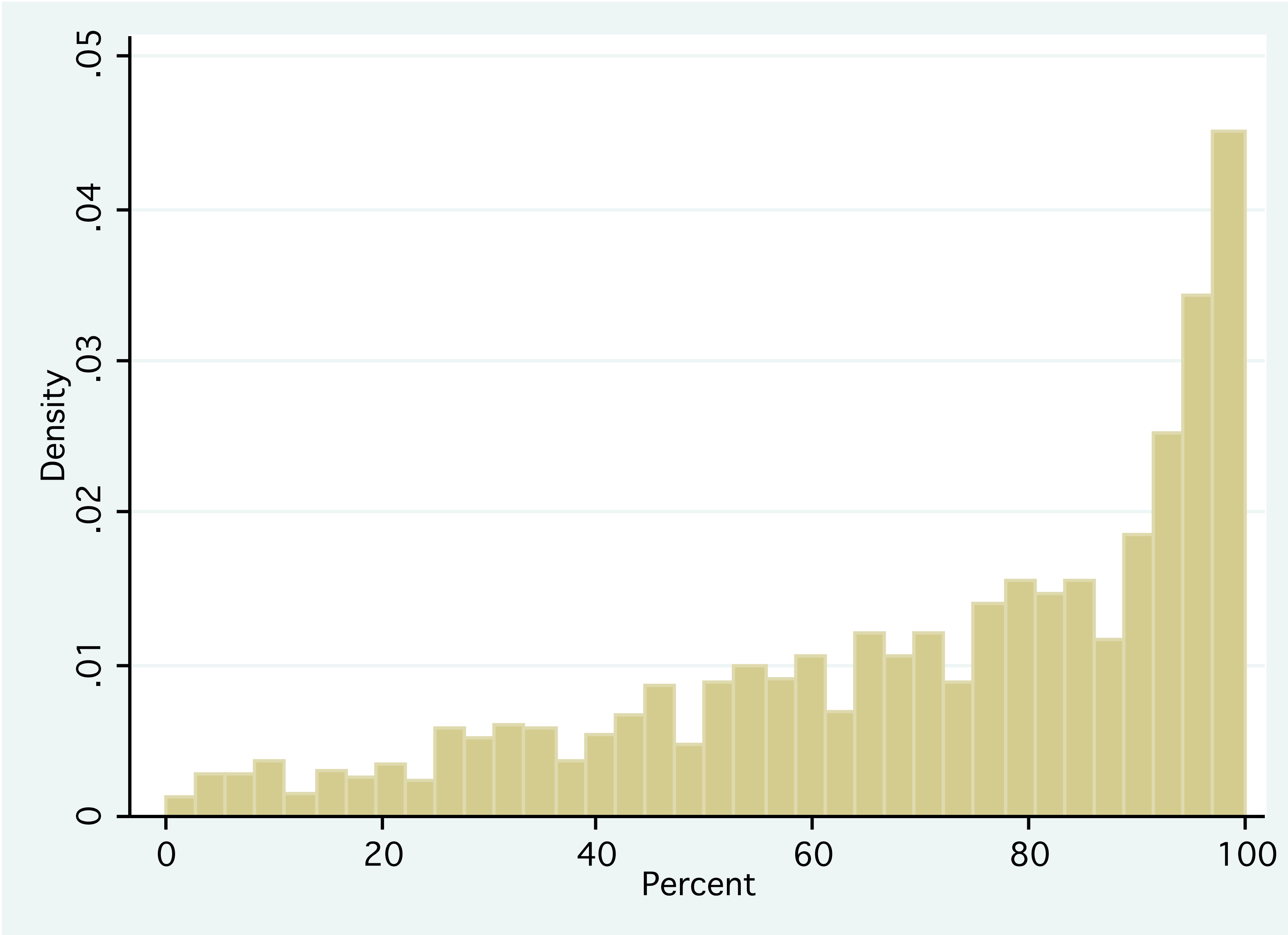


Figure 6: Percentage of Total Earnings from Lobster Trips by Fisher-Fishing Season - Trappers

of Lob Trips by Fisher-Fishyear - dive.pdf

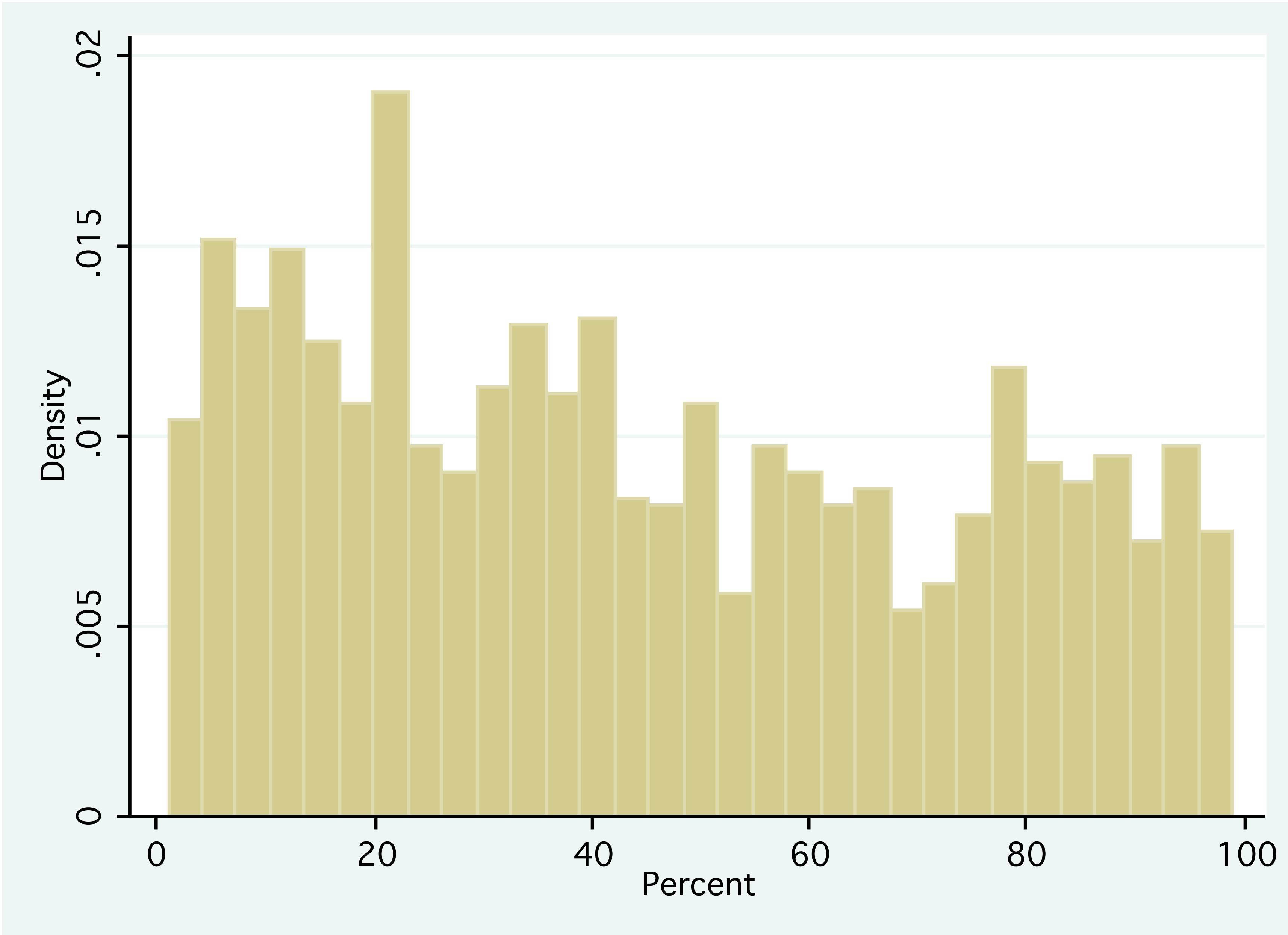


Figure 7: Percentage of Total Trips that are Lobster Trips by Fisher-Fishing Season - Divers

of Earnings from Lob Trips by Fisher-Fishyear - dive.pdf

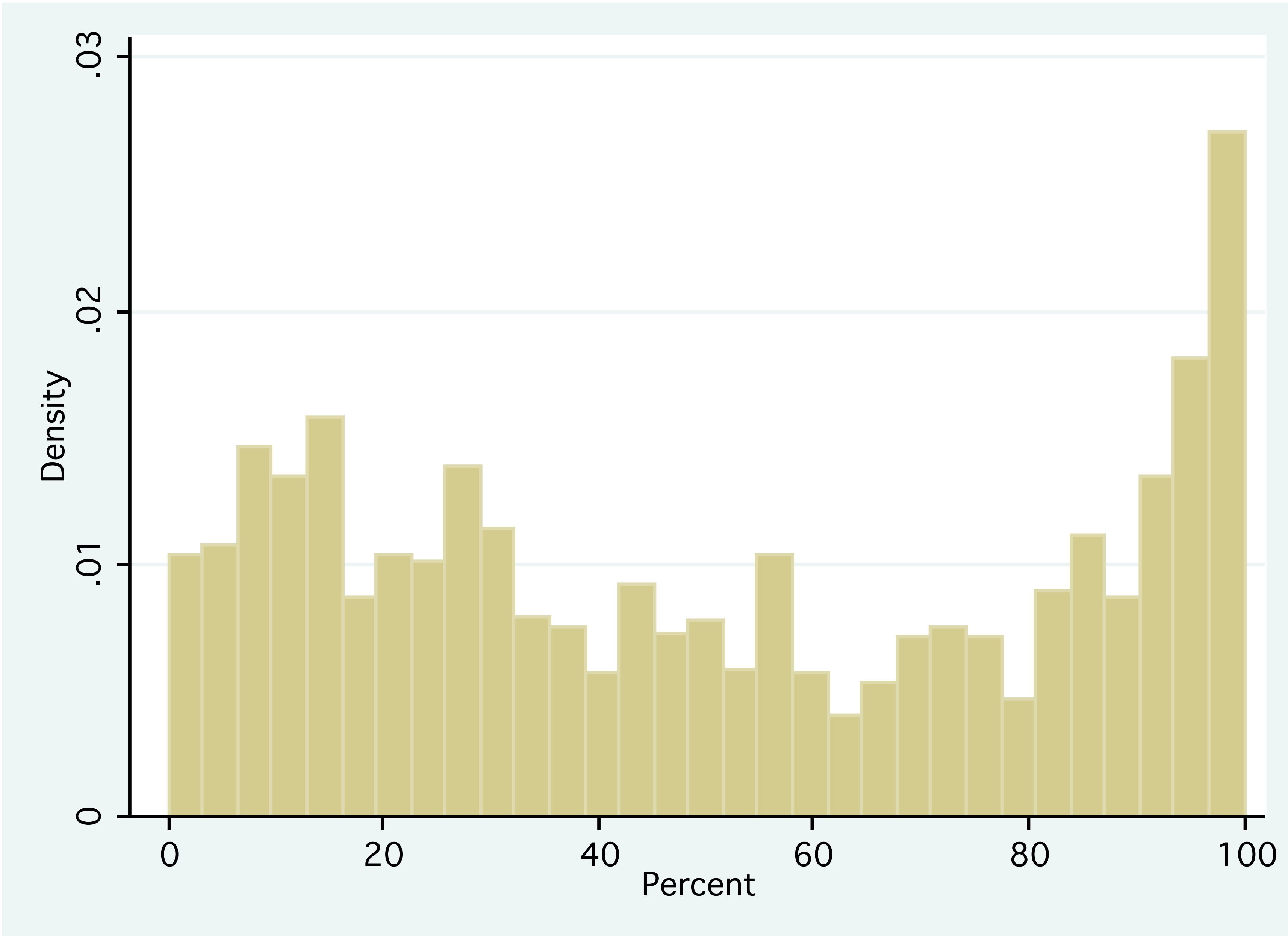


Figure 8: Percentage of Total Earnings from Lobster Trips by Fisher-Fishing Season - Divers

Table 3: Summary Statistics, Extensive Margin

	Unweighted			Weighted				
Variable	Mean	Std Dev	N	Mean	Std Dev	N	Min	Max
Trappers								
Possible days at sea	429	256	794	617	197	93,714	70	770
Actual days at sea	118	111	794	222	125	93,714	5	650
Participation rate	0.249	0.138	794	0.348	0.141	93,714	0.036	0.843
Lifetime revenue ($)	167,804	219,406	794	317,585	277,822	93,714	414	1,795,352
Per trip revenue ($)	1,339	1,498	794	1,422	1,204	93,714	71	16,365
Divers								
Possible days at sea	334	222	371	540	217	16,946	70	770
Actual days at sea	46	58	371	119	106	16,946	5	507
Participation rate	0.120	0.084	371	0.201	0.132	16,946	0.033	0.657
Lifetime revenue ($)	30,876	65,173	371	74,748	103,726	16,946	230	625,668
Per trip revenue ($)	623	736	371	676	801	16,946	40	6,070

Table 4: Summary Statistics, Intensive Margin

	Unweighted			Weighted				
Variable	Mean	Std Dev	N	Mean	Std Dev	N	Min	Max
Trappers								
Possible days at sea	254	203	191	438	243	9,367	70	770
Actual days at sea	49	58	191	118	94	9,367	5	369
Participation rate	0.189	0.120	191	0.264	0.126	9,367	0.042	0.657
Lifetime revenue ($)	54,864	106,503	191	159,041	190,354	9,367	414	759,329
Per trip revenue ($)	889	742	191	1,119	809	9,367	79	3,897
Divers								
Possible days at sea	290	204	210	462	224	6,688	70	770
Actual days at sea	32	36	210	73	54	6,688	5	204
Participation rate	0.105	0.072	210	0.156	0.105	6,688	0.033	0.585
Lifetime revenue ($)	19,324	51,523	210	51,992	110,187	6,688	230	625,668
Per trip revenue ($)	530	524	210	607	701	6,688	40	4,005

Table 5: Step 1 - Reduced Form Probit Model of Participation

	Trappers			Divers		
Variable	Coef.	s.e.	z-stat	Coef.	s.e.	z-stat
September	-0.148	0.015	-9.56	-0.587	0.016	-36.24
October	-0.279	0.021	-13.40	-0.673	0.023	-29.05
Saturday	0.322	0.083	3.87	-0.193	0.086	-2.23
Age x Saturday	-0.007	0.002	-4.39	0.003	0.002	1.81
Sunday	-0.106	0.096	-1.09	-0.431	0.101	-4.27
Age x Sunday	-0.005	0.002	-2.57	0.003	0.002	1.51
Unemployment Rate	0.014	0.012	1.18	-0.047	0.010	-4.93
Wind Speed	-0.077	0.003	-24.26	-0.071	0.003	-20.59
Lagged Wind Speed	0.030	0.003	9.45	-0.016	0.003	-4.83
Full Moon	-0.237	0.023	-10.30	-0.022	0.024	-0.94
Time Trend	-0.017	0.003	-5.04	-0.026	0.003	-8.59
Observations	47,740			59,360		
# of Unique Fishermen	191			210		
Log likelihood	-20,780			-17,811		

Table 6: Step 2 - Selectivity-Corrected Log-Wage Equation, Wage = Daily Earnings/Hours at Sea

	Trappers			Divers		
Variable	Coef.	s.e.	z-stat	Coef.	s.e.	z-stat
September	-0.117	0.019	-6.10	-1.276	0.088	-14.46
October	-0.233	0.030	-7.63	-1.432	0.108	-13.26
Wind Speed	-0.007	0.007	-1.04	-0.119	0.014	-8.38
Lagged Wind Speed	0.018	0.004	4.49	-0.015	0.010	-1.52
Full Moon	-0.343	0.029	-11.67	0.007	0.063	0.12
Time Trend	-0.005	0.004	-1.31	-0.017	0.009	-1.95
Inverse Mills Ratio	0.112	0.093	1.21	2.309	0.164	14.06
Observations	47,740			59,360		
# of Unique Fishermen	191			210		

Table 7: Step 3 - Selectivity-Corrected Hours at Sea Equation, Wage = Daily Earnings/Hours at Sea

	Trappers			Divers		
Variable	Coef.	s.e.	z-stat	Coef.	s.e.	z-stat
Predicted Wage	0.079	0.040	1.97	0.935	0.131	7.13
September	0.002	0.009	0.23	0.291	0.100	2.92
October	0.000	0.014	0.02	0.282	0.120	2.34
Saturday	0.052	0.051	1.02	-0.293	0.196	-1.50
Age x Saturday	-0.001	0.001	-0.89	0.005	0.004	1.19
Sunday	0.070	0.061	1.15	-0.774	0.224	-3.45
Age x Sunday	-0.001	0.001	-0.82	0.008	0.005	1.80
Unemployment Rate	0.022	0.006	3.47	-0.025	0.029	-0.89
Time Trend	0.025	0.002	13.74	-0.002	0.008	-0.30
Inverse Mills Ratio	-0.017	0.037	-0.44	1.902	0.220	8.65
Observations	47,740			59,360		
# of Unique Fishermen	191			210		

Table 8: Step 4 - Structural Probit Model of Participation, Wage = Daily Earnings/Hours at Sea

	Trappers			Divers		
Variable	Coef.	s.e.	z-stat	Coef.	s.e.	z-stat
Predicted Wage	0.866	0.062	13.88	0.621	0.026	23.66
September	-0.066	0.017	-3.96	0.202	0.039	5.16
October	-0.150	0.024	-6.29	0.210	0.048	4.36
Saturday	0.318	0.083	3.86	-0.191	0.086	-2.21
Age x Saturday	-0.007	0.002	-4.33	0.003	0.002	1.80
Sunday	-0.121	0.096	-1.26	-0.430	0.101	-4.26
Age x Sunday	-0.004	0.002	-2.48	0.003	0.002	1.51
Unemployment Rate	-0.003	0.012	-0.28	-0.050	0.009	-5.30
Time Trend	-0.010	0.003	-3.06	-0.016	0.003	-5.09
Wage Elasticity (1)	1.294	0.094	13.80	1.152	0.050	23.17
Wage Elasticity (2)	1.307			1.161		
Observations	47,740			59,360		
# of Unique Fishermen	191			210		
Log likelihood	-21,011			-17,814		

Table 9: Step 3 - Selectivity-Corrected Traps Pulled Equation, Wage = Daily Earnings/# of Traps Pulled

	Trappers		
Variable	Coef.	s.e.	z-stat
Predicted Wage	0.080	0.053	1.51
September	-0.029	0.011	-2.54
October	-0.187	0.018	-10.45
Saturday	0.079	0.068	1.17
Age x Saturday	-0.001	0.001	-0.59
Sunday	0.068	0.082	0.84
Age x Sunday	-0.001	0.002	-0.86
Unemployment Rate	0.011	0.009	1.24
Time Trend	0.018	0.002	7.42
Inverse Mills Ratio	-0.037	0.051	-0.73
Observations	47,740		
# of Unique Fishermen	191		

Table 10: Step 4 - Structural Probit Model of Participation, Wage = Daily Earnings/# of Traps Pulled

	Trappers		
Variable	Coef.	s.e.	z-stat
Predicted Wage	0.862	0.060	14.28
September	-0.087	0.016	-5.39
October	-0.292	0.020	-14.46
Saturday	0.319	0.083	3.86
Age x Saturday	-0.007	0.002	-4.33
Sunday	-0.120	0.096	-1.26
Age x Sunday	-0.004	0.002	-2.49
Unemployment Rate	-0.004	0.012	-0.29
Time Trend	-0.014	0.003	-4.32
Wage Elasticity (1)	1.289	0.091	14.19
Wage Elasticity (2)	1.301		
Observations	47,740		
# of Unique Fishermen	191		
Log likelihood	-21,005		

Table 11: Step 4 - Structural Probit Model of Participation, Wage = Daily Earnings

	Trappers			Divers		
Variable	Coef.	s.e.	z-stat	Coef.	s.e.	z-stat
Predicted Wage	0.822	0.056	14.77	0.410	0.017	23.61
September	-0.059	0.017	-3.56	0.156	0.037	4.16
October	-0.135	0.024	-5.65	0.174	0.047	3.72
Saturday	0.319	0.083	3.87	-0.191	0.086	-2.21
Age x Saturday	-0.007	0.002	-4.34	0.003	0.002	1.80
Sunday	-0.120	0.096	-1.25	-0.430	0.101	-4.26
Age x Sunday	-0.004	0.002	-2.49	0.003	0.002	1.51
Unemployment Rate	-0.004	0.012	-0.31	-0.050	0.009	-5.33
Time Trend	-0.028	0.003	-8.18	-0.020	0.003	-6.48
Wage Elasticity (1)	1.229	0.084	14.68	0.761	0.033	23.12
Wage Elasticity (2)	1.241			0.767		
Observations	47,740			59,360		
# of Unique Fishermen	191			210		
Log likelihood	-20,998			-17,815		

Table 12: Step 1 - Reduced Form Probit Model of Participation, Full Sample

	Trappers			Divers		
Variable	Coef.	s.e.	z-stat	Coef.	s.e.	z-stat
September	-0.213	0.005	-39.16	-0.586	0.011	-54.41
October	-0.342	0.007	-47.12	-0.731	0.016	-46.70
Saturday	-0.115	0.030	-3.85	-0.018	0.058	-0.31
Age x Saturday	-0.000	0.001	-0.43	-0.002	0.001	-1.36
Sunday	-0.586	0.034	-17.37	-0.195	0.066	-2.95
Age x Sunday	0.002	0.001	3.51	-0.004	0.001	-2.57
Unemployment Rate	-0.022	0.004	-6.00	-0.022	0.007	-3.23
Wind Speed	-0.087	0.001	-81.20	-0.076	0.002	-33.00
Lagged Wind Speed	0.030	0.001	29.11	-0.014	0.002	-6.41
Full Moon	-0.219	0.008	-27.30	-0.045	0.016	-2.81
Time Trend	-0.029	0.001	-31.46	-0.023	0.002	-11.56
Observations	337,610			120,750		
# of Unique Fishermen	794			371		
Log likelihood	-173,745			-40,645		

Table 13: Step 2 - Selectivity-Corrected Log-Wage Equation, Full Sample, Wage = Daily Earnings

	Trappers			Divers		
Variable	Coef.	s.e.	z-stat	Coef.	s.e.	z-stat
September	-0.166	0.007	-25.03	-0.946	0.039	-24.49
October	-0.315	0.010	-31.94	-1.139	0.051	-22.35
Wind Speed	-0.013	0.002	-6.09	-0.077	0.006	-12.33
Lagged Wind Speed	0.028	0.001	22.74	-0.002	0.004	-0.56
Full Moon	-0.351	0.009	-38.21	-0.029	0.027	-1.08
Time Trend	0.013	0.001	11.95	0.005	0.004	1.30
Inverse Mills Ratio	0.314	0.025	12.58	1.466	0.076	19.41
Observations	337,610			120,750		
# of Unique Fishermen	794			371		

Table 14: Step 4 - Structural Probit Model of Participation, Full Sample, Wage = Daily Earnings

	Trappers			Divers		
Variable	Coef.	s.e.	z-stat	Coef.	s.e.	z-stat
Predicted Wage	0.856	0.019	44.51	1.035	0.028	36.95
September	-0.104	0.006	-17.03	0.386	0.030	13.03
October	-0.173	0.009	-19.59	0.436	0.038	11.51
Saturday	-0.119	0.030	-3.99	-0.015	0.058	-0.26
Age x Saturday	-0.000	0.001	-0.15	-0.002	0.001	-1.39
Sunday	-0.593	0.034	-17.71	-0.193	0.066	-2.91
Age x Sunday	0.002	0.001	3.71	-0.004	0.001	-2.58
Unemployment Rate	-0.045	0.004	-12.64	-0.026	0.007	-3.73
Time Trend	-0.038	0.001	-39.91	-0.028	0.002	-13.79
Wage Elasticity (1)	1.089	0.025	44.20	1.818	0.050	36.04
Observations	337,610			120,750		
# of Unique Fishermen	794			371		
Log likelihood	-176,286			-40,659		

Table 15: Sample Selection Tests, Step 3, Wage = Daily Earnings/Hours at Sea

	Trappers			Divers		
Variable	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Predicted Wage	0.064 *	0.079 **	0.090 **	0.915 ***	0.935 ***	0.823 ***
	(0.038)	(0.040)	(0.039)	(0.128)	(0.131)	(0.127)
September	0.000	0.002	0.007	0.279 ***	0.291 ***	0.235 **
	(0.009)	(0.009)	(0.009)	(0.100)	(0.100)	(0.101)
October	-0.003	0.000	0.006	0.266 **	0.282 **	0.193
	(0.013)	(0.014)	(0.014)	(0.118)	(0.120)	(0.124)
Saturday	0.042	0.052	0.000	-0.221	-0.293	-0.287
	(0.050)	(0.051)	(0.050)	(0.189)	(0.196)	(0.258)
Age x Saturday	-0.001	-0.001	0.000	0.003	0.005	0.006
	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.006)
Sunday	0.089	0.070	0.080	-0.870 ***	-0.774 ***	-0.990 ***
	(0.060)	(0.061)	(0.062)	(0.220)	(0.224)	(0.295)
Age x Sunday	-0.001	-0.001	-0.001	0.011 **	0.008 *	0.013 **
	(0.001)	(0.001)	(0.001)	(0.004)	(0.005)	(0.006)
Unemployment Rate	0.019 ***	0.022 ***	0.026 ***	-0.044	-0.025	-0.025
	(0.006)	(0.006)	(0.006)	(0.029)	(0.029)	(0.035)
Time Trend	0.023 ***	0.025 ***	0.022 ***	0.001	-0.002	-0.010
	(0.002)	(0.002)	(0.002)	(0.008)	(0.008)	(0.011)
Inverse Mills Ratio	-0.018	-0.017	-0.027	1.940 ***	1.902 ***	1.940 ***
	(0.037)	(0.037)	(0.035)	(0.220)	(0.220)	(0.245)
Observations	53,130	47,740	35,840	79,450	59,360	27,650
# of Unique Fishermen	217	191	158	276	210	111

Table 16: Sample Selection Tests, Step 4, Wage = Daily Earnings/Hours at Sea

	Trappers			Divers		
Variable	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Predicted Wage	0.818 ***	0.866 ***	0.795 ***	0.594 ***	0.621 ***	0.569 ***
	(0.060)	(0.062)	(0.069)	(0.025)	(0.026)	(0.025)
September	-0.069 ***	-0.066 ***	-0.100 ***	0.195 ***	0.202 ***	0.178 ***
	(0.016)	(0.017)	(0.018)	(0.038)	(0.039)	(0.042)
October	-0.153 ***	-0.150 ***	-0.206 ***	0.200 ***	0.210 ***	0.174 ***
	(0.023)	(0.024)	(0.026)	(0.046)	(0.048)	(0.052)
Saturday	0.319 ***	0.318 ***	0.178 **	-0.143 *	-0.191 **	-0.142
	(0.080)	(0.083)	(0.090)	(0.080)	(0.086)	(0.119)
Age x Saturday	-0.007 ***	-0.007 ***	-0.005 ***	0.002	0.003 *	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Sunday	-0.092	-0.121	-0.243 **	-0.484 ***	-0.430 ***	-0.560 ***
	(0.093)	(0.096)	(0.101)	(0.096)	(0.101)	(0.139)
Age x Sunday	-0.005 ***	-0.004 **	-0.003 *	0.005 **	0.003	0.006 **
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Unemployment Rate	-0.010	-0.003	0.008	-0.057 ***	-0.050 ***	-0.047 ***
	(0.012)	(0.012)	(0.013)	(0.009)	(0.009)	(0.011)
Time Trend	-0.018 ***	-0.010 ***	-0.007 **	-0.013 ***	-0.016 ***	-0.019 ***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Wage Elasticity (1)	1.281 ***	1.294 ***	1.053 ***	1.188 ***	1.152 ***	0.894 ***
	(0.094)	(0.094)	(0.092)	(0.051)	(0.050)	(0.040)
Wage Elasticity (2)	1.294	1.307	1.063	1.196	1.161	0.903
Observations	53,130	47,740	35,840	79,450	59,360	27,650
# of Unique Fishermen	217	191	158	276	210	111
Log likelihood	-21,780	-21,011	-18,425	-20,034	-17,814	-11,359