Intertemporal substitution, weekly target earnings or both? Evidence from daily labor supply of Southern Indian Fishermen

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Very preliminary

Abstract

We study the labor supply behavior of 279 South Indian fishermen using daily data on labor force participation and individual value of catches from 2000 to 2007. There exist two labor supply approaches with different policy implications. On the one hand, intertemporal substitution implies that workers substitute labor for leisure when wages are temporary higher. On the other hand, target-earnings models involve a target income level, beyond which, individuals stop working. Our paper provides an empirical test of these two theories. Preliminary results provide evidence of intertemporal substitution. Estimated elasticities are significantly positive and range between 0.5 and 0.6. We find weaker evidence of target-earnings behavior. Coefficients on recent earnings are significant and negative. In particular, at average fishermen's characteristics, a ten percent increase of the weekly value of catches decreases the likelihood of participation in 2.5 percentage-points.

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1 Introduction

A large body of literature has investigated the response of work effort to transitory wage shocks. There exist two main hypotheses with very different policy implications. On the one hand, there is the neoclassical theory, which implies that workers substitute leisure for labor when wages are temporarily higher. On the other hand, target-earnings models involve a target income level, beyond which, individuals stop working. Thus, the latter set of studies implies the opposite result: in days with higher hourly earnings, workers work less. Our paper provides an empirical test of these two alternatives.

The relevance of distinguishing the relative importance of each model is underscored by unemployment policy recommendations that each model yields. If individuals work less when pay is lower, then positive correlation between unemployment rates and economic turndowns turns out to be consequence of intertemporal substitution. However, if workers have an income target goal, this association is reflecting that workers who would like to work more when pay is lower are being laid off. A key policy implication is how government transfers and labor tax policies react to business cycles. Since a deep understanding of labor supply is critical for policy implications, we need to aim for reliable elasticity estimates.

In this paper, we first measure labor supply responses and go a step further by analyzing the role of heterogeneity in participation decisions. Second, unlike most of the previous literature, our paper is the first one studying a low-income population, a broadly common occupation and a developing country.

Understanding the responsiveness of workers' effort to wages is important for labor related transfer and tax government policies, particularly for low-income individuals. Moreover, development literature (Banerjee and Duflo, 2007) suggests that poorest individuals live near subsistence levels and have limited access to credit. Hence, we might think that they are the most susceptible group to have a minimum subsistence level target type of behavior. Since lowest income individuals are precisely the most affected by labor tax reforms and layoffs, having a better understanding of their labor supply responses and characteristics is most policy relevant and may be different from the rest of population and occupation groups analyzed until now.

The first approach to measure labor elasticity was to use life cycle models using data of annual wage variations. Most studies using this approach find small or even negative elasticities of labor supply[1] . While these results imply that individuals do not respond much to changes in wages,

[1] See Blundell and Macurdy (1999) for a comprehensive review of the literature.

results can be driven by the nature of the data used. Most of these analysis use annual data in wages and hours worked. However, annual changes in wages may affect lifetime wealth of individuals and are mostly not transitory. Moreover, evidence suggests that many workers are constrained in their choices of hours or days worked (Kahn and Lang 1991; Dickens and Lundberg 1993).

In order to tackle this problematic, more recent work considers environments in which workers are free to choose their daily or hourly labor supply. Since daily changes in wages should not have a significant effect on lifetime wealth, exogenous wage changes should identify intertemporal elasticity of labor.

Within this latter literature there exists a debate about the interpretation of results. Camerer et al. (1997) and Chou (2000) find negative labor supply elasticities for NYC and Singapore taxi drivers respectively. Authors argue that taxi drivers behave as target earners. That is, when daily earnings' target is achieved, drivers will finish their shift, independently of hours worked. However, critics argue that these negative elasticities may be a result of elements that simultaneously affect demand and supply. For example, suppose that during bad weather, taxi demand and earnings increase. If taxi drivers do not like to work under those conditions we will observe higher earnings and lower supply. Thus, we may erroneously conclude that they behave as target earners.

Oettinger (1999) uses data on stadium vendors and finds elasticities in the .55-.65 range. He instruments earnings with game attendance to show that ignoring endogeneity yields severely downward biased elasticity estimates. However, since he does not have information on other sources of earnings for vendors, he cannot directly test whether cumulative earnings affect participation decisions.

Farber (2005) directly tests target earnings behavior with NYC Taxi drivers. He uses a hazard model and finds that the probability of stopping in any given day depends on cumulative hours worked, not on cumulative earnings. Nevertheless, Farber does not have any instrument allowing him to predict earnings and estimate labor supply elasticities too.

Fehr and Goette (2007) propose a variation from the target earnings behavior: Reference Dependent Preferences (RDP). In this model, preferences are characterized by individuals having a daily income reference in mind that causes a convex utility cost if it is not achieved.

Thus, an increase in wages can increase effort at first to achieve the individual income goal and then reduce effort once the target is reached. As in the neoclassical model, on the extensive margin RDP predicts that higher temporary wages increase participation, i.e., positive elasticity of participation. However, the difference relies on the intensive margin: when wages increase, workers reach the target in fewer hours and afterwards reduce effort per hour. The degree of

target earnings behavior in this model is proportional to the degree of loss aversion, that is, how sensitive is the individual to trying to avoid a unit below than to making a unit above the target.

In order to test this hypothesis, authors conduct a randomized experiment temporarily raising salaries of bicycle messengers in Switzerland. They find that messengers facing higher wage rates work more shifts that compliers but also reduce effort per shift. Authors argue that their results are most consistent with a Reference-Dependent utility model[2]. In addition, they measure messengers' degree of loss aversion[3] and find that messengers with larger negative effort elasticities are also more loss-averse. Hence, Fehr and Goette shed light on the importance of preferences and heterogeneity when measuring elasticities.

Most recently Farber (2008) goes a step further by using a structural model to estimate individual reference income targets for NYC Taxi drivers. Using a larger NYC cab drivers data set than Farber, Doran (2009) estimates individual labor supplies and finds evidence of heterogenous reference dependent points and that these increase proportionally to permanent increases in wages (fares).

We study the labor supply behavior of 279 South Indian Fishermen using daily data on labor force participation and individual value of catches from 2000 to 2007. Our setup allows us to analyze effects of temporary (daily) changes in earnings on labor supply. Hence, our first goal is test both intertemporal substitution and weekly target earnings behavior.

Second, we use additional rich survey data to analyze more extensively the role of heterogeneity in labor responses to wages. Given that we have an average of 1,000 observations per worker, we can draw a distribution of individual elasticities and match it to individual characteristics. An example of one of the characteristics that we will look at is whether they say they have a weekly earnings target and if so, how much the target is. We will then get more compelling evidence of the existence or not of target earnings behavior together with a deeper understanding of the role of heterogeneity in response to wage increases.

Our preliminary results provide evidence of intertemporal substitution. In our preferred specifications, elasticities are significantly positive and range between 0.5 and 0.6. Our findings all suggest smaller but stastistically significant target earnings behavior. In particular, at average fishermen's characteristics, a ten percent increase in the weekly value of catches decreases the likelihood of participation in 2.5 percentage-points. These results are consistent with reference dependant preferences

Our next step is to analyze which are the individual traits positively correlated with higher elasticities.

[2]See Kahneman and Tversky (2000) for a selection of papers.

[3]Measured by observing choices between different lotteries. For details see Ferh and Goette 2007.

2 Background

2.1 Fishermen

We study 279 Fishermen from eight villages in the southern part of the coast of the golf of Bengal: 30 are located in Idindakari, 28 in Kootapanai,15 in Manapad, 43 in Periyathalai, 29 in Thomayar Puram and 66 in Uvari and in Patnam too. Figure 1 shows their exact location.

Households belong to the catholic fishing community of the village, which converted about 400 years ago from the fishermen's Hindu Cast. Thus, following their religion, fishermen usually work from Monday to Saturday.

On a typical night, a boat owner goes to sea around 1am together with three or four labourers who help him out. These workers are paid on a daily basis a salary of approximately 200 Rupees. Once out, every fisherman decides in which direction to sail and which type of net to throw depending on the fish species he expects to catch in that particular spot. Then, they wait a few hours and pick up their catches. Of course, here fisherman's experience, laborers ability, weather conditions and pure luck play an important role for the success of the catch.

Around 7am they head back to the beach. There, every fisherman has a so called "auctioneer" from whom he borrows money to pay for the gear and boat-related expenses. Moreover, he also acts as a wholesaler and markets the vast majority of the catch to multinational fish-processing companies. This market works as a monopsony: companies are the only ones that buy 45 different fish species at a given market price which depends on the season and the type of fish. Examples of the type of seafood traded are sharks, cat-fish, rays, crabs and lobsters.

The remaining smaller fish are sold at the local market. In exchange of marketing and loan services, auctioneers keep a commission of seven percent of daily sales. On top of that amount, they keep a ten percent of the value of total catches which he deducts from the principal owed by the boat owner. Finally, another three percent is kept and put into a savings account whose balance is refunded to the fisherman in December for the celebration of Christmas and New Year, the major holiday season among fishermen. Note, that these flexible repayment agreement provides the fishermen with some source of insurance, since in low income days, their loan payments are lower. Moreover, once in the contract, additional debt is costless for the fisherman since the amount of compensation he pays to the auctioneer is independent of the amount he owes. It thus comes as no surprise that more successful boat owners are granted larger loans. The contract may be terminated by the boat owner at any time if he can pay back his outstanding loan balance. If a boat owner switches auctioneers, the new auctioneer settles the debt with the previous one. However, switching of auctioneers rarely occurs. According to villagers, the superiority of this interlinked

share arrangement over separate debt and marketing contracts is a result of first, limited liability of the fisherman and, second, costless monitoring of the fisherman's day-to-day success by the auctioneer[4].

Information about the success of individual boat owners flows freely since, on every day, all fish is traded at the same place and observed by all auctioneers who are present. Moreover, auctioneers keep thorough hand-written records of all sales and loan transactions and, at the end of each year, give a copy of individual sales records to each of their fishermen. Each boat owner can thus document precisely his record of catches. These are the records we use in our analysis for the years 2000-2007, which yield a total of approximately 300,000 observations.

In the village of Patnam, auctioneers are administrated by an NGO which recovers information for all fishermen. In the rest of the villages, auctioneers records are not centralized and we have a random sample of auctioneers.

Fishermen and their wives are surveyed in 2005 and 2007. They are asked about a large variety of topics such as socio-demographic characteristics, networks, other sources of income, inventory of assets, income shocks, savings, a set of subjective questions about how did they felt after the 2004 Tsunami and results of loss-aversion games. More interestingly, surveys contain a module about fishing expenses and techniques together with a question about whether they have weekly earnings target and its specific amount.

2.2 Determinants of catches

Surveys include a battery of questions about which elements were important to predict catches. According to fishermen answers, month, wind East to West and the lunar calendar are the best predictors of a good fishing day in terms of catches. They are also asked if they have access to weather forecasts, and how accurate those are. Most state that they have radios from which they obtain weather previsions.

In order to estimate predicted catches as close as fishermen do, we acquired daily weather characteristics from the closest Indian Meteorological Department station. This data is available for all years except from 2007. As we can see in Figure 1, Tutiturin station is approximately 20km. away from the nearest village.

A broad body of literature in natural science and land economics (a sample are Smith 2002 and 2005, and Watson and Pauly, 2001) support the hypothesis that weather conditions, expertise -when and where to go fishing for a particular species- and luck are the main factors that affect

[4]Limited liability is also Basu's (1992) key argument for the predominance of share contracts in agricultural areas of low income countries. Platteau and Nugent (1992) provide a useful general discussion of contract choice in fisheries of low-income economies.

catch abundance.

In addition, consistent with fishermen tools to predict catches, there is some evidence within biology literature about the relationship between fish abundance and lunar phases. There are several suggested channels through which lunar phases may affect fish abundance and consequently catches.

Some authors state that lunar phase is related to fish abundance through its relation to night brightness. Luecke et al. (1993) state that when there is a full moon in Utah lake fish stay in deeper areas to hide from detection of potential predators.

Nevertheless, the most supported hypothesis is that lunar phases affect fish behavior through its relation to migration patterns and reproduction cycles. For example, Tesch (1989) finds that around full moon, eels remain in deeper areas of the Mediterranean Sea. He argues that this is not a result of moon brightness, since these animals stay too deep to notice light changes.

However, the most compelling studies come from experimental evidence. Entright (1975) and Hastings (1981) show that for different species, vertical (depth) and horizontal migration and reproduction patterns are not altered under laboratory conditions (constant light, temperature and tide), that is, such behavior is unrelated to other environmental elements that may be affected by the lunar cycle as well. Robertson et al. (1990) argue that the reason for such pattern is that there exist some positive externalities in breeding and egg protection when fish synchronize their reproduction cycles, which happen to follow lunar periods. Nevertheless, migration and reproduction patterns are likely to be idiosyncratic to particular species and geographical areas. For example, Barlow et al. (1986) and Zucker (1978) find that crabs in the coast of the US were closer to the sea to mate only during full and new moons. The opposite occurs during quarter moons.

We did not find scientific evidence for the particular type of fish that fishermen in this study usually catch. Nevertheless, given the evidence of the relationship between lunar phases and catches and its use by these fishermen, our last piece of information corresponds to the lunar cycles within the period of study, 2000 to 2007.

3 Descriptive Statistics

Table 1 depicts fishermen's descriptive statistics. On average, fishermen are forty years old and live in households with a total of five family members. Since all are married, one of these family members is their wife. In most cases, remaining relatives are children. Nevertheless, some boat owners have extended family members living with them, such as in law's, parents or siblings. In all households, boat owners earnings' are the main source of income. However, there is usually another

family member who works as well. This can be another male, a child, or a woman manufacturing items sold at the informal market.

Fishermen have approximately 5.5 years of education. That should allow them to manage their own finances and decide in a daily basis whether it is worth it to go fishing. As we can see in Table 1, their daily gross average earnings are 1,024 Rupees. Since the survey includes a few questions about the amount of their daily expenses on kerosene and labourers' wages, we can get a rough estimate of their net daily income, 250 Rupees, which are approximately five US $. In addition to such costs, fishermen have to pay commissions on their catches to auctioneers, as well as eventually boat, motor and nets' repairs. Hence, there may be days when they will not catch enough to cover costs. In fact, the variance of average daily earnings is almost as large as average earnings, which shows the risk boat owners face every day when deciding to go to shore. Therefore, this risk together with other possible random shocks to opportunity costs explains why fishermen's average likelihood to work is 0.73 instead of being closer to one. Since fishermen are catholic, they do not work on Sundays, and thus, they work an average of four days a week.

Since participations' sensitivity to earnings also depends on income, we would like to get an idea to what extent fishermen might be financially challenged. Their average savings are low. In particular, they are lower than average daily earnings of two days of work. In addition, their average yearly net earnings are roughly two thirds of the average income per capita in India, which is 33,000 Rupees (approximately 700 US dollars). Note that this statistic is underestimated, since fishermen face auctioneers' commission and boat maintenance costs.

Finally, our survey includes questions about target earnings behavior, which can help to shed light on fishermen's labor supply responses to recent earnings. Table 2 reports answers to these questions. In particular, they are asked if they have a target, its amount, how many days it takes them to reach it and what do they do if they reach (or not) such a target. All individuals state that they need to satisfy a weekly target, which is 9,354 Rupees on average: a target that is approximately 2,000 Rupees higher than actual average weekly earnings. There are two possible explanations for this divergence. Either they rarely reach their target or they misunderstood the question. It may well be the case that fishermen answer what they would ideally catch every week and not what their real target is. The rest of the answers within this set of questions will rather support the last hypothesis. For example, regarding the number of days needed to reach that target, most of them answer that it takes six days to reach it, which is precisely the usual total number of weekly working days.

A sign of possible real target earnings behavior is shown in the high proportion of individuals, 80 percent, who state that they would go fishing that night if they had not reached the desired

target by then. Nevertheless, the puzzle here is that they also say that, if they were to reach the target earlier than expected, they would not stop fishing. If they were pure target earners, they should stop working when the target is achieved. Thus, it seems that if fishermen tend to work the usual working days, independent of recent earnings and the answer of whether they have a target is rather misleading.

4 Empirical Strategy

To asses to what extent boat owners intertemporally substitute labor for leisure when earnings are temporally higher, we estimate the following structural model of participation:

$$\begin{aligned} y_{it} &= 1(y_{it}^* > 0), \\ y_{it}^* &= \alpha \ln(w_{it}^e) + \beta \ln(\sum_{p=1}^{7} w_{it-p}) + X_{it}\gamma + \theta_i + e_{it}, \end{aligned} \tag{1}$$

where y is a dummy equal to one if fisherman i goes fishing at date t when his expected value of catches (w_{it}^e) is greater or equal than his opportunity cost. θ_i are individual effects[5] and X_{it} are opportunity cost shifters such as weather conditions, month, year, holidays and day of the week dummies.

The majority of the prior literature on daily labor supply uses data on taxi drivers and analyzes the labor supply equation (working hours) and daily target earnings. Our setup is slightly different: boat owners do not have such flexibility in their choice of hours worked. They need to stay at least a minimum of hours waiting for the nets to be filled with fish and they all meet approximately at the same time at the beach to sell the catch. Hence, since their major decision is at the extensive margin, we analyze their participation equation and weekly target earnings. It is true that fishermen might decide to change effort per hour or leave to sea a couple of hours earlier or later than average depending on earnings. Unfortunately, we can not directly test this hypothesis, since we do not have data on the exact daily hours they spend working.

To test whether fishermen substitute leisure for labor when earnings are higher or rather work less when they have high recent earnings (or both), we would like to have consistent estimates of α and β. If $\alpha > 0$ and $\beta = 0$, then fishermen's behavior is consistent with short-term intertemporal substitution; if instead $\alpha = 0$ and $\beta < 0$, fishermen are less likely to work when recent value of catches have been higher and hence, they behave as target earners instead. Thus, if recent

[5]Since we have an average of 1,000 observations per individual, our probit model including individual dummies does not suffer from the incidental parameters problem (Chamberlain, 1980).

earnings have been higher, the target is achieved earlier and the less likely are they to participate, while expected earnings should not matter.

A third possibility is that they both tend to work when earnings are higher and take into account recent earnings, i.e., both coefficients are different from zero ($\alpha > 0$ and $\beta < 0$). This would be consistent with reference dependent preferences, that is, boat owners might work more in days with higher expected earnings to achieve their income target, but once this goal is achieved, they may reduce their likelihood to go fishing. Under this scenario, marginal utility of leisure increases once the income target is achieved and fishermen work only if expected earnings are large enough. In this case we would be interested in knowing whether the net effect on labor force participation of a temporary increase of expected earnings is on average negative or positive.

Since we only observe earnings for boat owners who go fishing, we first estimate the following earnings equation:

$$\ln(w_{it}) = Z_{it}\delta + \mu_i + u_{it} \tag{2}$$

In a second stage we use predicted log-earnings from (2), and estimate the structural probit equation (1). Standard errors are corrected for the induced sampling error incorporated with the introduction of an explanatory variable, which is itself estimated (Topel-Murphy, 1985).

In a natural way, some variables affecting earnings Z_{it} are opportunity cost shifters as well. Therefore, they also belong to X_{it} in equation (1). An example is the rain: both fishermen and fish may dislike rainy days. If this was to be true, in a rainy day, fishermen would be less likely to go shore and hidden fish less likely to be caught. Hence, in order to identify our parameters of interest, we need at least some variables that affect participation only through earnings.

We assume that lunar phase dummies and a set of month-year interactions are credible instruments for value of catches. On the one hand, as we have argued before, phases of the moon are shown to be related to fish availability. Moreover, it is difficult to argue that lunar cycles directly affect boat owners' opportunity costs.

On the other hand, month-year interactions serve as a proxy for seasonal changes in fish prices set by multinational companies. Year and month dummies are included in both equations (1) and (2). Since, for example, in months when fishermen might be more likely to fall sick, they may work fewer days. Nevertheless, it is more difficult to think about elements that explain participation not through seasonal changes in prices and that are specific to a particular month in a particular year. Excluding this last set of instruments increases the magnitude of the labor supply estimates but not their sign or precision.

It is important to note that the individuals in our study are all active workers and thus, have already decided that it is worth it to become a fisherman. Thus, conditional on earnings, individual

ability or industriousness and further elements that may affect how often they go to shore in a particular time of the year, participation should be random. Hence, since we include individual dummies in both equations, we should not worry about selection. We rather use (2) to do a wage imputation. However, in order to confirm this hypothesis, we also added a preliminary third step by estimating first a Heckman model for participation. We excluded a set of interactions of individual characteristics with year dummies from the earnings equation. As expected, adding the estimated inverse Mills-Ratio from the participation equation into (2) turns out not to matter: the selection term is insignificant and estimates in (1) and (2) are not significantly different from the ones without correcting for selection.

5 Results

Before turning to the results for the structural participation model of interest, Table 3 presents estimates of the reduced-form model of participation. Although this simple model does not allow us to identify our parameters of interest, it provides a preliminary idea of variables that are important for determining participations either through earnings or opportunity costs. All four specifications include individual dummies, year, month, village, month and year interactions and dummies for the number of days they have worked within the previous seven days. Columns (2) and (4) include weather controls for the years we have information, 2000 to 2006. Columns (3) and (4) include a variable that is the sum of the value of earnings during the last seven days of the week. Common variables' coefficients do not differ significantly across specifications.

In all columns, the total number of fishermen -except i-, who go fishing is significant and positively linked to the likelihood of participating. Nevertheless, the marginal effect is close to zero. This suggests evidence of intertemporal substitution: if fishermen tend to work in days with high expected earnings and they also have some source information -unavailable to us- about how good a day will be in terms of earnings, it is likely that in higher earnings days, more boat owners will go fishing. Thus, the total number of boat owners is a proxy for this unobservable information. Nevertheless, there might be other reasons why fishermen tend to go sea when other colleagues go as well. For example, there may exist peer effects, i.e. boat owners may like to go fishing with other workers or, they might face less risks if there are more boats sailing around.

In the last two columns, the logarithm of recent value of earnings in the last two columns is significant and positively related to the likelihood of participation. We will see later that earnings are serially correlated, which makes this variable might is proxy of expected earnings. Thus, at first glance, boat owners are more likely to work when earnings are higher.

Turning to our first set of instruments that we will use to impute earnings, phase of the moon

dummies, we can see that compared to a full moon phase, fishermen tend to participate more during the first quarter lunar phase. We believe this association is caused by its possible effect on abundance of fish and earnings. Nevertheless, none of these estimates is significantly different from zero. The remaining set of instruments, year and month dummies, which proxy for seasonal changes in prices, are all significant and jointly significant with a χ^2 statistic higher than 60 in all specification (not reported).

In the specifications with weather controls (columns 2 and 4), we observe that participation is lower when average wind speed and total rain fall are higher, although coefficients are not significant. We may imagine that when weather is not favorable fishermen are less likely to go fishing either because they prefer not work in unfavorable conditions or because they expected lower earnings.

Interestingly, for all specifications, fishermen are most likely to sea on Mondays than on any other day of the week. Since they exert a very intense physical activity in their job and they do not work on Sundays, it makes sense to think that they will be most rested on Mondays and thus, more likely to work. Besides Mondays, fishermen are more likely to work on Saturdays than in any other day of the week. Following the previous argument, boat owners might be more likely to go fishing on a Saturday if they know they will be resting the day after.

Consistent with their religion, fishermen also tend to rest during catholic holidays. Although this may not be a decision if fish-processing companies and local markets are closed during local holidays. In addition to Sundays and catholic holidays, fishermen -and only fishermen- have the tradition not to work on the first Friday of every month. Hence, they are also less likely to work during this fishermen's holiday. Moreover, in households with more income earners, boat owners are less likely to work during a holiday. This variable can capture that families have less need for the head of household to work when there are other sources of income available or that have more kids and prefer then to stay together during holidays.

Finally, we include a set of dummies for the number of days within that particular week that they have been working in all specifications (not reported). These variables capture time varying individual effects such as changes in ability, tiredness, information or individual propensity to work. For example, fishermen who have been working recently more often than the rest are perhaps better informed about how good or bad catches have been recently. All these set of variables are significantly different from zero. Fishermen who have been fishing during all working days within a week are more likely to participate than their counterparts and marginal effects are increasing (in absolute value) in the days they have been working that week.

Table 4 shows results for the log-earnings equation which we use to predict expected earnings for

all fishermen. Both columns include boat owner's fixed effects, year and month dummies, month-year interactions and dummies for the number of days they have worked within the previous seven days. Column (2) includes observations for which we have information on total rain fall and average wind speed. We see how earnings are serially correlated, since recent cumulative value of catches are good predictors of present earnings. Since introducing a lagged dependent variable together with autocorrelation leads to inconsistent estimates and incorrect variance-covariance matrix, we test for autocorrelation. Unfortunately, we should be careful, since we reject the hypothesis that errors do not follow an autocorrelation of order one. When we estimate a model that accounts for such an error structure, estimates do not change significantly. However, we do not know if that is actually the real error structure or if errors follow another pattern. In that case, we are making an incorrect assumption. Future versions of this paper will try to present specifications that do not present this problem.

Moving back to Table 4, we see that the number of fishermen who go fishing is positively correlated with earnings as in the reduced form results from Table 3. As we have discussed earlier, this might capture, besides other elements, some common knowledge about how good a day is going to be that boat owners use to decide to go fishing.

Earnings are significantly higher during the last quarter of the lunar cycle compared to the rest of lunar phases. This result is consistent with the most supported hypothesis that fish reproductive and migration patterns are coordinated by lunar cycles. Nevertheless, biology studies in this area have not analyzed, as far as we know, what is the particular case for the Indian Ocean.

Month-year interactions are all significant, except the ones corresponding to 2001. These dummies are also jointly significantly different from zero, with a χ^2 statistic higher than 100 in both specifications.

Strikingly, weather variables do not seem to affect earnings of fishermen who work. Nevertheless, maybe our environmental variables are not the best proxies for environmental conditions that are important to predict catches.

Not surprisingly, the day of the week, except from Wednesday, does not significantly affect the value of catches and as we should expect, they do not follow any particular pattern. It only seems as if almost in every day except from Tuesday, they get higher catches than in Saturday. According to some informal interviews with fishermen, there is no tragedy of the commons, that is, it is not the case that when more fishermen go to sea, the amount of catches is lower. Moreover, the price for the vast majority of catches is fixed by the fish-processing companies. Nevertheless, if for some reason people tend to buy less fish at the local market on Saturdays, the remaining fish sold through an auction may be sold at a lower price, which could lead to lower earnings.

Unfortunately, we do not have daily information about the exact daily proportion of fish sold at the local market and its value.

Thus, if we believe that, conditional on all these controls the value of catches in a certain day depends on how lucky fishermen are, the coefficient of expected earnings on participation will allow us to measure participation elasticity.

Hence, let us turn to Table 5, which depicts results for our main model of interest: a structural participation probit. The set of excluded variables from this participation equation are the phases of the moon and the set of year-month interactions. Columns (2) and (4) include observations for the days for which we have information on average wind speed and total rain fall. These specifications include predicted value of earnings derived from a model that also includes weather variables. In these two columns, we see how, unlike in the reduced form equation from Table 3, during windy days, boat owners are significantly less likely to sail. In columns (3) and (4), we include the logarithm of the sum of the value of catches for the last seven days to test for target earnings behavior.

Fishermen are more likely to work on Mondays and Saturdays. As discussed earlier, this is probably because they get a chance to rest a day before and after Sunday. Again, boat owners are significantly less likely to go fishing during any other holiday. This probability is even lower, when there are additional income earners in the household.

Turning to our two main coefficients of interest, we see that, consistent with intertemporal substitution, coefficients on predicted logarithm of earnings are positive and significant in all specifications. The bottom panel of Table 5 reports uncompensated elasticities evaluated at fishermen's average characteristics as well as the mean of individual elasticities. All of them are significantly different from zero and range between 0.1 and 0.6. It is important to note that elasticities are severely downward biased when we omit recent earnings, a variable that is significant and positively correlated with expected earnings.

Coefficients for the logarithm of the value of recent earnings in columns (3) and (4) are negative and significantly different from zero. In particular, they imply that an increase in earnings of ten percent decreases the likelihood of participation in approximately 2.5 percentage points. Hence, compared to participation elasticities, the magnitude of this effect is half as large. Thus, we can not rule out some kind of target earnings behavior. Therefore, as discussed in Section 4, a positive coefficient of expected earnings together with a negative sign on recent earnings implies that fishermen both tend to work when earnings are higher, and take recent earnings into consideration too, i.e. $\alpha > 0$ and $\beta < 0$. This results seem consistent with our third hypothesis that fishermen have reference dependent preferences.

6 Discussion

The study of labor supply is a fundamental pillar in labor economics. In this paper, we use daily data on Indian fishermen's participation and value of catches to test three labor supply behavior hypothesis: Intertemporal substitution, target earnings and reference dependent preferences.

According to our preliminary empirical results, we find evidence that Indian fishermen have reference dependent preferences. That is, these workers take into account expected earnings as well as recent earnings in their daily labor supply decisions.

Our results have two implications for future labor supply analysis. First, short-term labor supply models should include recent earnings conditional on recent hours or days worked as a explanatory variable. Since recent earnings are positively correlated with expected earnings and are negatively related the probability of participation, omitting this variable yields are severely downward biased elasticities' estimates.

Second, this paper sheds light on possible differences between labor supply behavior of poor workers and their counterparts. A recent study shows differences in savings and risk management behavior in developing countries (Banerjee and Duflo, 2007). We provide evidence that such differences are also translated into the labor supply. Future versions of this paper will analyze the possible channels originating these differences.

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Figure 1: Villages and Weather Station Location

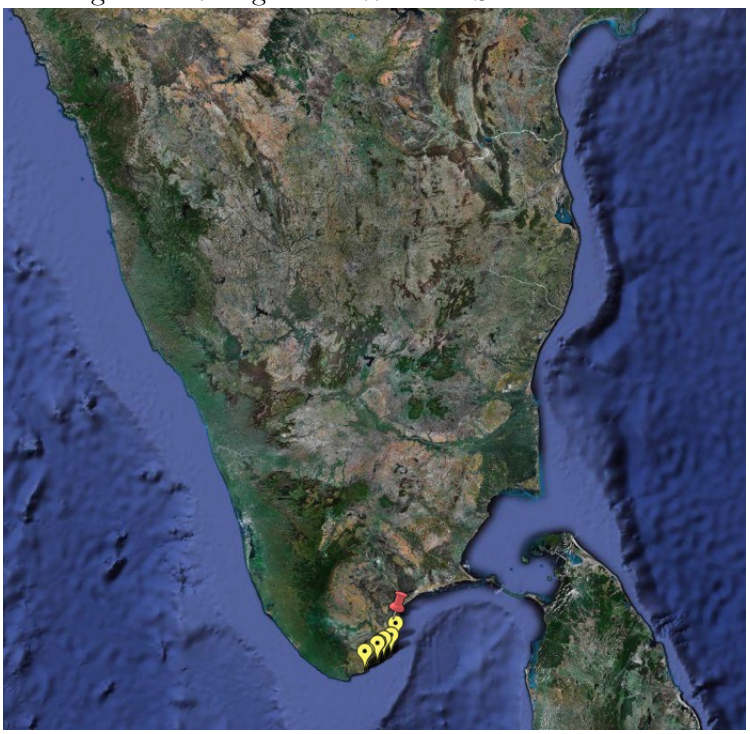

Table 1: Fishermen Characteristics

Age	40.16
	(9.43)
Total family members	4.93
	(1.57)
Number of Income earners	2.164
	(1.32)
Number of children	2.46
	(1.57)
Years of education	5.469
	(2.23)
Savings in Rupees	430
	(3,069)
Daily participation	0.73
	(0.44)
Daily value of catches	1,028
	(887)
Daily costs in kerosene and laborers	770
	(245)
Weekly earnings	4,482
	(3,107)
N	279

Table 2: Weekly Target Earnings Questions

Need to satisy a weekly target earnings	1
	(0)
Amount of the target	9,354
	(3,698)
Days needed to reach that target	6
	(0.13)
What do you do if you don't reach the target?	
Go fishing at night	0.91
Go on a Sunday	0.04
Nothing: keep fishing the usual days	0.04
What do you if target is achieved earlier?	
Stop fishing for the week	0.01
More likely to take some day off	0.03
Nothing: keep fishing the usual days	0.96

Table 3: Reduced Form Participation Equation Probit

y=Pr(participation)	(1)	(2)	(3)	(4)
Log (last 7days value of catches)			0.103***	0.108***
			(0.0186)	(0.0183)
Total fishermen	0.0160***	0.0158***	0.0160***	0.0158***
	(0.00211)	(0.00230)	(0.00211)	(0.00231)
First Quarter	0.0295	0.0390	0.0280	0.0375
	(0.0331)	(0.0345)	(0.0330)	(0.0343)
Newmoon	-0.00872	-0.0114	-0.00938	-0.0121
	(0.0261)	(0.0275)	(0.0261)	(0.0274)
Last Quarter	-0.00542	-0.00748	-0.00527	-0.00750
	(0.0264)	(0.0275)	(0.0267)	(0.0278)
Average Wind Speed		-0.00112		-0.000992
		(0.00134)		(0.00133)
Total Rain Fall in mm		-0.0180		-0.0183
		(0.0253)		(0.0257)
Monday	0.0179	0.0162	0.0178	0.0161
	(0.0138)	(0.0144)	(0.0137)	(0.0143)
Tuesday	-0.0430*	-0.0414*	-0.0428*	-0.0411*
	(0.0222)	(0.0233)	(0.0222)	(0.0233)
Wednesday	-0.0566*	-0.0504	-0.0566*	-0.0501
	(0.0313)	(0.0319)	(0.0313)	(0.0319)
Thursday	-0.0695**	-0.0655**	-0.0694**	-0.0652**
	(0.0296)	(0.0295)	(0.0297)	(0.0296)
Friday	-0.0647*	-0.0585*	-0.0643*	-0.0580
	(0.0335)	(0.0355)	(0.0335)	(0.0355)
First Friday of the month	-1.629***	-1.896***	-1.642***	-1.922***
	(0.267)	(0.219)	(0.265)	(0.197)
Catholic holiday	-0.204**	-0.226**	-0.203**	-0.224**
	(0.0978)	(0.0957)	(0.0991)	(0.0976)
Holiday*Num Income Earners	-0.0473**	-0.0315*	-0.0466**	-0.0308*
	(0.0212)	(0.0172)	(0.0212)	(0.0172)
Observations	290419	262950	290132	262663
Mean Participation	0.73	0.72	0.73	0.72
	(0.44)	(0.45)	(0.46)	(0.46)

All include boat owner dummies, month, year and month-year interactions and dummies for the number of days they worked during the previous week. Errors are clustered at year and village levels.

Table 4: log(Earnings) Equation

y=log(value of catches)	(1)	(2)
Log (last 7days value of catches)	0.49***	0.475***
	(0.024)	(0.0240)
Total Fishermen	0.00051**	0.000661**
	(0.00024)	(0.000278)
First Quarter	-0.011	-0.0144
	(0.010)	(0.0111)
Newmoon	-0.017	-0.0154
	(0.010)	(0.0105)
Last Quarter	0.031**	0.0328**
	(0.012)	(0.0132)
Average Wind Speed		-0.00104
		(0.000810)
Total Rain Fall in mm		0.00830
		(0.00938)
Monday	0.010	0.00775
	(0.0079)	(0.00864)
Tuesday	-0.0046	-0.00532
	(0.0079)	(0.00902)
Wednesday	0.012*	0.0120
	(0.0067)	(0.00737)
Thursday	0.0034	0.00297
	(0.0060)	(0.00637)
Friday	0.0039	0.00320
	(0.0064)	(0.00711)
Observations	209917	187160
Number of Boatowners	249	248
R-squared	0.179	0.163
Mean log(vc)	6.5	6.5
	(0.8)	(0.8)
Mean Value Catches	918	904
	(786)	(788)
Observations	209917	187160

All include boat owner fixed effects, month, year, month-year interactions and dummies for the number of days they worked during the previous week. Errors are clustered at year and village levels.

Table 5: Structural Participation Equation Probit

y=Pr(participation)	(1)	(2)	(3)	(4)
Predicted l(earnings)=Alfa	0.254***	0.273***	1.378***	1.528***
	(0.0105)	(0.0112)	(0.25)	(0.32)
Log (last 7days value of catches)=Beta			-0.585***	-0.629***
			(0.13)	(0.16)
Total Rain Fall in mm		-0.00147***		0.000610
		(0.000567)		(0.000576)
Average Wind Speed		-0.108***		-0.109***
		(0.00777)		(0.00779)
Monday	0.0354***	0.0378***	0.0234**	0.0265***
	(0.00935)	(0.00973)	(0.00938)	(0.00975)
Tuesday	-0.108***	-0.108***	-0.101***	-0.0981***
	(0.00916)	(0.00954)	(0.00917)	(0.00956)
Wednesday	-0.152***	-0.142***	-0.162***	-0.152***
	(0.00912)	(0.00950)	(0.00914)	(0.00952)
Thursday	-0.169***	-0.163***	-0.169***	-0.162***
	(0.00911)	(0.00948)	(0.00911)	(0.00949)
Friday	-0.317***	-0.307***	-0.313***	-0.299***
	(0.00908)	(0.00945)	(0.00909)	(0.00947)
First Friday of the month	-2.216***	-2.440***	-2.192***	-2.411***
	(0.0653)	(0.0773)	(0.0654)	(0.0775)
Catholic holidays	-0.783***	-0.716***	-0.762***	-0.692***
	(0.0365)	(0.0385)	(0.0366)	(0.0387)
Holiday*Num Income Earners	-0.0321**	-0.0222	-0.0323**	-0.0217
	(0.0135)	(0.0142)	(0.0135)	(0.0143)
Observations	290132	262663	290132	262663
Participation Elasticities				
Ind. Part Elasticities Mean	0.1	0.11	0.56	0.63
	(0.02)	(0.02)	(0.1)	(0.11)
Elasticity at Mean chara.	0.11	0.12	0.6	0.68
	(0.04)	(0.01)	(0.02)	(0.3)

All include boat owner, month, year dummies

and dummies for the number of days they worked during the previous week.

Topel-Murphy corrected errors.