Online Appendix for "State Taxation of Nonresident Income and the Location of Work"

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A Appendix

A.1 PGA Qualification

Golfers that are not card holders for the PGA Tour must participate in the Korn Ferry Tour and either win three events or place in the top 75 and play the golfers ranked 126-200 in the PGA Tour at the Web.com Tour Championship. The top 50 finishers in the Web.com Tour Championship tournament receive PGA cards for the following season. Additionally, in tournaments marked as open, people can participate in Monday sessions to qualify for the larger event later in the week. If they consistently qualify and perform well enough to be in the top 125 of points, they would receive a tour card. Previously this was based upon earnings alone, whereas points are now a function of placements and tournaments.[30] There are also special rules for winners of the Majors.[31] those that win any of the major events receive a five year automatic tour card renewal. The PGA Tour tournaments generally have two different tournament eligibility rules: most events are "open" tournaments that all PGA Tour members are eligible to participate in and a handful of "invitationals" that can limit participation to only certain golfers.[32]

A.2 Data and Residency Status from Media Guides

We combine data from golfstats.com and the PGA Tour Media Guides. An overview of the data available is in Figure A.1, showing the online data scraped from golfstats and the residency information digitized from the Media Guides.

In order to properly measure residency for golfers we use the PGA Tour Media Guides between 1977 and 2018, excluding 2003, which is missing from the PGA Tour archives. Overall, 85 percent of golfers have some residency information in the media guides and the tour guides cover 65 percent of golfer-year observations before any extrapolation of residency information. In order to make sure golfers have a residence for every year and are as close to their true residency as possible, we fill in observations where residency information is missing but where we have information on prior and latter residency. If a golfer does not have a residency change between two observed years from which they appeared in the media guide, we simply fill in the residency information in the missing years. If a golfer changes residency somewhere in the range of missing years, the midpoint between the missing years is used to mark the change in residence. Similarly, the first observed residence is used to fill in any previous residences and the last observed residence is used to fill in any following residences. Golfers who never appear in the media guide, which are a small share of golfer-year observations (mainly low-quality golfers who only play a few years on the PGA Tour), are dropped from the data set.

[30] This is not a common method to earn a tour card, with Jordan Speith being a notable exception.

[31] The Masters Tournament, PGA Championship, U.S. Open, and the Open Championship are the four most selective tournaments.

[32] For concerns about identification, these eligibility rules are time invariant.

We could use the residency information we scraped from online sources, but because this residency information is only observed at the time of scraping, we do not use it because the error would become larger for golfers in the data earlier in the sample. We have verified the results are robust to dropping extrapolated data and to including golfers we drop, but using their 2018 address. Table A.1 shows summary statistics on the number of moves. Less than 3% of golfer year observations involve a move, of which about 25% do not involve a tax change (e.g., moving from one zero tax state to another).

The distribution of the location of golfers/tournaments is provided in Figure A.2.

A.3 Quality Index Construction

We use Lubotsky and Wittenberg (2006) to construct a data-driven measure of player quality. We use N proxy variables of player quality to construct the index, denoting the n^{th} proxy variable as $Z^n_{i,y}$. The N proxy variables include age, lagged values of earnings, the golfer's lagged top placement, the golfer's lagged average placement, the lagged number of tournaments entered, and both the lagged share and lagged count of top 5, top 10, and top 25 placements. Critical to identification is that these proxies are exogenous to the current participation decision. We then regress realized earnings for a tournament, w_{ity}, on the set of exogenous proxy variables, obtaining a coefficient β^n on each proxy variable. This regression with multiple proxies can then be used to construct an index Z^{ρ}_{iy}:

$$Z^{\rho}_{iy} = \frac{1}{\beta^{\rho}} \sum_{n=1}^{N} \beta^n Z^n_{iy}, \tag{A.1}$$

where $\beta^{\rho} = \sum_{n=1}^{N} \beta^n \frac{cov(w_{ity}, Z^n_{iy})}{cov(w_{ity}, Z^1_{iy})}$. We select the normalization, $cov(w_{ity}, Z^1_{iy})$, such that the quality results are benchmarked to the number of tournaments participated in in the previous year, however, this normalization is irrelevant in our setting. The use of this index creation procedure dominates any ad hoc index creation method.[33] Using the index values for each golfer-year, we create year-specific deciles of quality such that a given player (e.g., Tiger Woods) in a given year (e.g., 2005) is assigned to a specific decile in that year (e.g., Tiger Woods in 2005 is in the 10th decile). Using these deciles, grouped earnings are constructed in the following manner:

$$w^{\mathbb{E}}_{dty} = \frac{1}{G_d} \sum_{i_d=1}^{G_d} w_{ity}, \tag{A.2}$$

where w_{ity} is the realized earnings for individual i, in decile d, for tournament t, in year y and G_d is the number of golfers in the decile who participate in a tournament. The expected earnings $w^{\mathbb{E}}_{dty}$ is simply the cell average of earnings in a tournament by quality decile×year, which gives an estimate of earnings that is uncorrelated with any golfer specific residuals and is not affected by an individual's specific decisions. Construction of this grouped average includes those who participate and do not make the cut, so expected earnings can be zero in some instances for lower quality golfers.

As discussed above, when constructing the index, we use exogenous golfer characteristics and lagged measures of performance. Figure A.3 verifies that our index is

[33] In their paper, the procedure is constructed to minimize measurement error.

strongly correlated with contemporaneous performance. But, we subsequently discuss robustness checks.

In constructing our grouping estimator we use lagged and time invariant characteristics. However, mean reversion may bias the assignment of individuals to groups when using lagged variables as predictors. As a solution, we calculate the predicted group cells based not just on prior year predictors, but on an average over several past years. After calculating the group cell means using up to five year lags of prior performance, the results are robust.

A.4 Constructing the PTR using TAXSIM

Because of the decentralized nature of taxation in the United States, creating an accurate measure of tax liability is especially daunting. While TAXSIM (Feenberg and Coutts, 1993) does help greatly in this regard, in its current form, TAXSIM does not adjust for income earned in different states. As a result, this requires a careful and extensive use of TAXSIM to construct our PTRs. Recalling the formula for the participation tax rate:

$$\mathrm{PTR}_{ity} = \frac{\mathrm{T}_{sry}(\mathbb{E}(\mathrm{I}_{ity}|P_{ity}=1)) - \mathrm{T}_{sry}(\mathbb{E}(\mathrm{I}_{ity}|P_{ity}=0))}{\mathbb{E}(\mathrm{I}_{ity}|P_{ity}=1) - \mathbb{E}(\mathrm{I}_{ity}|P_{ity}=0)} \tag{A.3}$$

Note that the PTR, although based upon the summation of several decile-specific expected earnings, $w^{\mathbb{E}}_{dty}$, is subscripted with an i because it also depends upon an individual golfer's participation decisions at the start of the year and the individual golfer's residential location.

It is necessary to estimate taxes for when the golfer participates in a tournament and when they choose to forgo the tournament, while holding all other participation, and expected income, in tournaments constant in a given year. To do this, we assume golfers make a one-time decision on which tournaments to participate in at the start of the year.[34] Expected income I_{ity} is constructed by first taking the sum of expected earnings (see equation A.2) *for all tournaments that the golfer actually participates in.* Then, $\mathbb{E}(\mathrm{I}_{ity}|P_{ity} = 1)$ is then constructed by adding the expected earnings from tournament t if the golfer did not participate in that tournament and requires no modification if the golfer did participate in that tournament. Second, $\mathbb{E}(\mathrm{I}_{ity}|P_{ity} = 0)$ is constructed in a similar fashion except for subtracting expected earnings for the tournament if the golfer actually participated in it. Note that although expected earnings in a single tournament are indexed by decile d. Thus, all of the tournament-specific components of income I_{ity} are decile-specific, but income is subscript by i because it depends on the choice of other tournaments that each individual plays in. Finally, for each golfer×tournament×year, we have to estimate their expected PTR from their expected income. Again, although the inputs are decile specific, the PTR varies by individual even for golfers that participate in the same set of tournaments because the home state of residence may differ across golfers.

An example would be a golfer in 2010 who resides in Florida and potentially competes in 3 tournaments, one in Arizona, and two in Georgia. At the start of the year, this golfer decides to participate in all tournaments. Given his decile, assume that expects to earn 100,000 in each tournament he participates in. Given Florida has no income tax, we can focus on the employment states. Then for his tournament in Arizona,

[34] We will subsequently explore the robustness of this assumption.

his PTR would be:

$$\text{PTR} = \frac{[\text{T}_{\text{FED}}(300,000) + \text{T}_{\text{AZ}}(100,000) + \text{T}_{\text{GA}}(200,000)] - [\text{T}_{\text{FED}}(200,000) + \text{T}_{\text{GA}}(200,000)]}{300,000 - 200,000}, \tag{A.4}$$

Where T_{FED} is the federal taxes due and T_{ST} are the taxes in a given state. The above expression ultimately simplifies to the additional taxes owed federally and the taxes on the 100,000 owed to Arizona divided by the 100,000 dollars he expects to earn:

$$\text{PTR} = \frac{\text{T}_{\text{FED}}(300,000) + \text{T}_{\text{AZ}}(100,000) - \text{T}_{\text{FED}}(200,000)}{100,000}. \tag{A.5}$$

His participation tax rate is 35.4, average tax rate is 27.3, and marginal tax rate is 41.2. While for each of his tournaments in Georgia, the participation tax rate would be:

$$\text{PTR} = \frac{[\text{T}_{\text{FED}}(300,000) + \text{T}_{\text{GA}}(200,000) + \text{T}_{\text{AZ}}(100,000)] - [\text{T}_{\text{FED}}(200,000) + \text{T}_{\text{GA}}(100,000) + \text{T}_{\text{AZ}}(100,000)]}{300,000 - 200,000}. \tag{A.6}$$

Then, for each tournament, we have the additional taxes on 100,000 dollars of income owed to the federal plus the additional taxes on the 100,000 dollars owed to Georgia, where he already owes taxes, divided by the 100,000 dollars in income. This simplifies to:

$$\text{PTR} = \frac{[\text{T}_{\text{FED}}(300,000) + \text{T}_{\text{GA}}(200,000)] - [\text{T}_{\text{FED}}(200,000) + \text{T}_{\text{GA}}(100,000)]}{300,000 - 200,000}. \tag{A.7}$$

The PTR is equivalent for both tournaments because expected earnings are the same for both tournaments. If the expected earners were not the same because of differences in the prizes, then the PTR would differ for both tournaments. If we put this example through TAXSIM, we calculate a PTR of 39.0, an ATR of 28.1, and an MTR of 43.9.

Now, suppose that the golfer could also participate in a tournament in California, where he also expects to earn 100,000 dollars. However, at the start of the year, he chooses not to participate for undisclosed reasons and we observe his non-participation. In this instance, each of the above PTRs remain unchanged because the PTR is based on the set of tournaments that the golfer decides to participate in at the beginning of the year (and the tournament being considered for participation). However, for the CA tournament he elects not to participate in, immediately showing the simplified expression, his PTR in CA is:

$$\text{PTR} = \frac{[\text{T}_{\text{FED}}(400,000) + \text{T}_{\text{CA}}(100,000)] - [\text{T}_{\text{FED}}(300,000)]}{400,000 - 300,000}, \tag{A.8}$$

where the PTR is only based off of his federal taxes on the additional 100,000 dollars he expects to earn and taxes on 100,000 dollars of income in California. Using TAXSIM, we estimate a PTR of 40.2, an ATR of 31.1, and an MTR of 46.15.

We can then estimate the PTR for all golfers by following NBER TAXSIM (Feenberg and Coutts, 1993) guidance for calculating the tax rate in a state[35]. If state taxes were simply based on residence, this would be all that would be necessary to compute the relevant PTR.[36]

However due to source based taxation, more work is required as TAXSIM does not

[35] All taxpayers assumed to be married, long term capital gains of 0.66 percent of earnings, 10 percent of income as mortgage interest/property tax/ other itemized deductions, and 2 percent of income as charitable contributions

[36] Granted, this would be a rather trivial and uninteresting exercise given we would lose all interesting variation in taxes due to tournament location and there would be no interstate shifting of earnings.

currently account for state nonresident income taxation and all income must be allocated to one state. For each golfer×tournament×year observation, we need to estimate the relevant tax rate the golfers face, taking into account that taxes are due to both the state of residence and the state where income is sourced and the relevant apportionment rules. As mentioned in the tax setting section, states have a few distinct ways of handling nonresident income taxes. For example, under the apportionment of all income earned in a state, if an individual living in Florida earns $100,000 in Alabama, his income tax liability would be based upon the $100,000 dollars earned in Alabama. By contrast, if taxes are apportioned based on the fraction of income in the state, if an individual lives in Florida and earns $300,000 in Florida and $100,000 in New Jersey, his total tax liability in New Jersey would be 25 percent of the taxes that would be owed if all $400,000 were taxed in New Jersey.

First, consider the scenario where states choose to only allocate income earned in that state. This leads to a straightforward calculation in TAXSIM where income is summed by state×year and is run through the nonresident state tax system. The taxes are then compared to the taxes owed to the resident state from earnings in the tournament state. If the resident taxes are greater, then the taxes are unchanged and if the taxes owed to the state of employment are larger then the additional nonresident state taxes are added to the residential taxes. The alternative apportionment method apportions all income to the nonresident state and then taxes are apportioned by the fraction of income earned in the nonresident state compared to Federal AGI. In order to best simulate this apportionment, we run TAXSIM with all income sourced in the nonresident state and multiply by the ratio between state specific nonresident income and income from all sources. This amount is similarly compared to the taxes due to the resident state and if the nonresident tax is larger, then it is added to the residential taxes in a similar fashion to the previous apportionment method.

The two different apportionment methods require us to run our data in TAXSIM 7 distinct times: two times for the total residence taxes for both playing and not playing in a tournament, two times for apportionment method 1 (only income earned in the employment state), two times for apportionment method 2 (fraction of income earned in the employment state), and one time to calculate the resident income taxes due from income earned in all other employment tax states so that the amount of residence income taxes due from work in the employment state can be calculated.

A.5 Event Study Treatments

Tables A.2 and A.3 show which states and years are treated in the event study. The tables separately show treatments by increases and decreases as well as for all changes and those driven by changes in the employment state.

A.6 Stacked Event Studies: Incidence

In order to further explore the incidence effects of tax changes on golfer earnings, we use our stacked event study framework and apply it to tournament prizes. In this instance, we aggregate our data to the tournament-year level and define treatment to be a 1 percentage point increase in the mean PTR across all golfers (not conditional on participation) for a given tournament. In addition, our control group is further limited to tournaments that experienced only small changes in the entire event window. The effect of these events on the tax rate is presented in Figure A.4a, showing that our treatment is a strong predictor of higher taxes after the reform. Figures A.4b, A.4c, and A.4d all show no clear relationship between tax increases on the total purse, the top prize, and our measure of expected earnings. In particular, the incidence on prizes bounces around zero. As we discuss in the paper, this is likely due to PGA tour prize rules.

A.7 Bootstrap Procedure

While the PTR is simulated using TAXSIM, the statistical properties should be similar to the average tax rates and marginal tax rates simulated in previous papers like Kleven, Landais and Saez (2013) and Moretti and Wilson (2017). In particular, compare the construction of the PTR to the ATR in Kleven, Landais and Saez (2013): they use a grouping estimator by country×year×foreign status×quality to directly estimate average tax rates, we instead use a tournament×year×quality grouping to construct earnings from the cell average of *realized* earnings from participants in that group. Then based upon the golfer's *realized* participation decisions, the PTR is constructed from the grouped earnings measure. Similarly, Moretti and Wilson (2017) use the top 1 percent of earnings to construct the average tax rate that each of their superstar scientists face in each state.footnoteIn addition, it is commonplace in the peer effects literature to include group averages in the estimating equation without modifications (Lavy and Schlosser, 2011; Carrell, Fullerton and West, 2009), suggesting that both the PTR and expected earnings should be accurate measures of the tax rate and what they would expect to win. Although we estimate quality deciles using a regression equation, the expectation that enters our tax rate is simply a group mean. This is done to mitigate concerns of using a generated regressor. Nonetheless, because group means are based on a regression equation predicting golfer quality, there may be some unmodeled uncertainty. For this reason we will always present bootstrapped standard errors, which improves upon the treatment of standard errors by the prior literature.

In our setting, bootstrapping the standard errors is complicated by the fact that for each bootstrap draw, we need to calculate the PTR in TAXSIM, which requires sending each sample multiple times through TAXSIM. Because we also have two-way clustering, the bootrap must sample over both clusters (golfers and tournament state). Then, we draw over golfer by tournament state to obtain the covariance necessary to obtain our standard errors (Cameron, Gelbach and Miller, 2011). This implies that for each bootstrap draw, our data needs to be sent through TAXSIM a total of 21 times.

Formally, we do this by first resample with replacement 500 times over the golfers clusters—note following Cameron, Gelbach and Miller (2011) the resampling is done over the entire clusters rather than over the individual observations. We then estimate the expected earnings measure on each sample and calculate the group means. We then separately calculate taxes in TAXSIM for each sample. Using this PTR, for each bootstrap sample, we estimate the regression for each sample and calculate the variance of these estimates. We repeat this exercise clustering by tournament state and golfer by tournament state in accordance with (Cameron, Gelbach and Miller, 2011) to obtain the bootstrapped standard errors.

A.8 Panel Regressions: Removing Individual Effects to Construct Ability

To shed additional light on the differences of the coefficients, we remove individual fixed effects from the data when constructing the group (decile) means.

Given the earnings are constructed using decile×year×tournament cell averages of earnings for participants, the expected earnings are not representative of the sample of participants and nonparticipants. Furthermore, one could imagine that because we use lagged quality measures, an over- or under-performing golfer could cause unwanted variation in the expected earnings. In order to adjust the decline means, we predict earnings of each tournament by estimating, separately for each decile and year,

$$w_{it} = \beta_0 + \delta_i + \delta_t + \varepsilon_{it}, \tag{A.9}$$

where $w_i t$ are observed earnings for golfer i in tournament t. In this specification, δ_i represents an individual fixed effect and δ_t represents a tournament specific fixed effect. After obtaining predicted vales $\widehat{w}_{it}$, we then subtract the individual specific fixed effect δ_i from the predicted value which produces means that are adjusted for individual performance differentials within a decile-year.

Under this approach, rather than use realized earnings to construct our expectation, we use the coefficient on the tournament fixed effects as an estimate of earnings in the tournament for each decile. The results, presented in Table A.4 show similar results, however, doing this allows us to interpret the wage term as the expected value of earnings in that decile. Then, the divergence between the expected wage and tax coefficients can be due to two factors. First, people are not good at forming expectations over earnings (i.e., player expectations are only loosely correlated with the accurate expectation we have created). Such errors in the golfers expectations could be a result of the player being overly optimistic/pessimistic. Second, golfers may not have enough information to form these expectations well. In other words, quality and ranking only loosely allow the golfer to form an expectation of earnings. Under such a view, the wage information is not salient and so golfers do not pay as much attention to earnings as they do to taxes.

A.9 Interpretation

It is often assumed that governments maximize revenue from top-earners. Our setting provides a clear example: given athletes are nonresidents, it is highly credible that the goal of taxes on out-of-state workers is to maximize revenue. Unlike many countries, state governments do not levy preferential rates on nonresidents. Assuming our estimates are applicable outside of the golf setting (so that the total number of working players each week is not fixed), our estimates shed light on whether state tax increases raise revenue from nonresidents *if* states could levy differentiated tax rates.

Following Agrawal, Foremny and Martínez-Toledano (2020), the change in tax revenue is positive if the elasticity is sufficiently small. Let ATR_s denote the average tax rate in state s and let $B_s(ATR_s)$ denote the income tax base. Then, differentiating revenue with respect to the ATR:

$$\frac{d\,(ATR_s \cdot B_s)}{dATR_s} \propto 1 - \frac{ATR_s}{1 - ATR_s}\epsilon_{1-ATR_s}. \tag{A.10}$$

To apply this formula, we assume participation responses are the only behavioral changes to the tax base. Then, we take the largest possible elasticity (for the top decile of players) with respect to the participation rate—2.09—and adjust it using equation (8), which yields $2.09 \times 0.84 = 1.759$. Using the Using the highest *average* tax rate (12.2%) over any state-year, implies that (A.10) evaluates to $0.878 > 0.122 \times 1.759$. The implication is clear: states are well to the left of the peak of the Laffer curve for taxing nonresident superstars. Obviously, this is a partial equilibrium analysis.

A.10 Alternative Index Creation

As a robustness exercise, we construct an alternative measure of earnings that is more straightforward that leads to broadly similar results. This is done by using a fractional probit to predict expected earnings. The fractional probit model allows us to scale tournament earnings to be between zero and one, where zero corresponds to missing the cut and one corresponds to the top prize of of the tournament. Using only tournament participants, we regress the scaled earnings on the same variables used in the Lubotsky and Wittenberg (2006) index. We then construct fitted values for both participants and nonparticipants. Similar to the prior approach, we divide the predicted values into year-specific deciles and assign earnings using the decile×year cell averages for all golfers.

All the results are robust to this alternative grouping estimator. The results of this alternative index can be seen in Tables A.5 along with Figure A.6. Results illustrate a similar pattern to those in the main text.

A.11 Robustness Checks

Table A.6 shows that the results are robust to excluding tournament by year fixed effects, as we discussed when presenting the estimating equation.

The remaining tables address robustness checks highlighted in Section 5.4. Table A.7 and A.8 show that the one-time decision of where to play is not critical. Table A.9 shows the results are driven by lower quality tournaments.

Figure A.5 visually shows our baseline regression using a binned scatter plot.

A.12 Data Sources

U.S. Bureau of Economic Analysis, Personal Consumption Expenditures: Chain-type Price Index [PCEPI], retrieved from FRED, Federal Reserve Bank of St. Louis; `https://fred.stlouisfed.org/series/PCEPI`.

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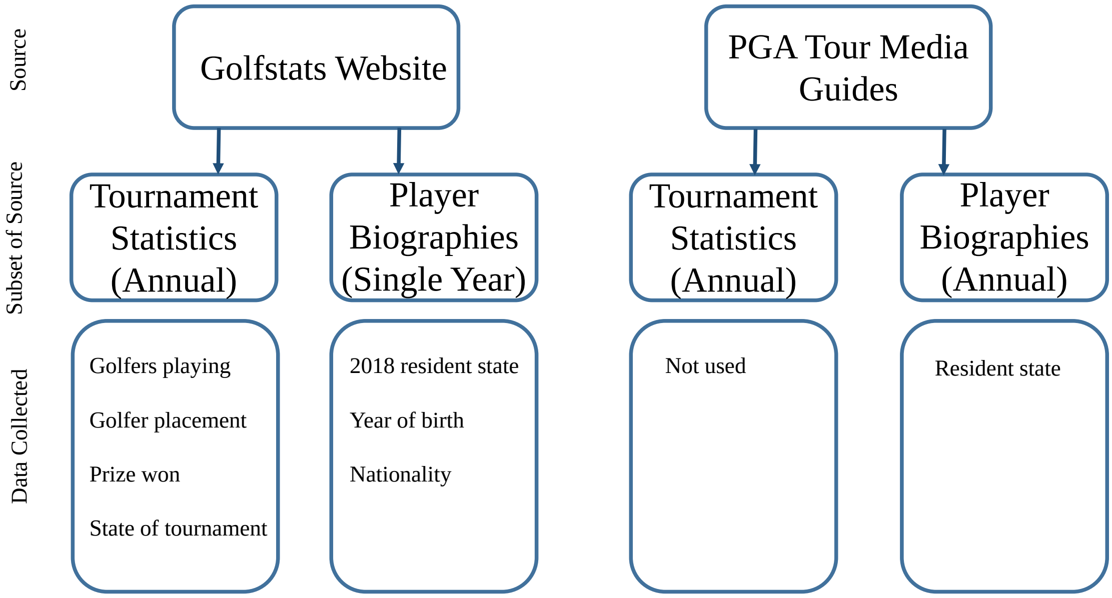
PGA Tour. 1982-2002. “The Tour Book 1982: Official Media Guide of the TPA Tour.” URLs provided in replication package.
PGA Tour. 2004-2018. “The Tour Book 1982: Official Media Guide of the TPA Tour.” URLs provided in replication package.
Steven Ruggles, Sarah Flood, Ronald Goeken, Megan Schouweiler and Matthew Sobek. IPUMS USA: Version 12.0 [ACS 2018]. Minneapolis, MN: IPUMS, 2022. https://doi.org/10.18128/D010.V12.0

A.13 Additional Figures

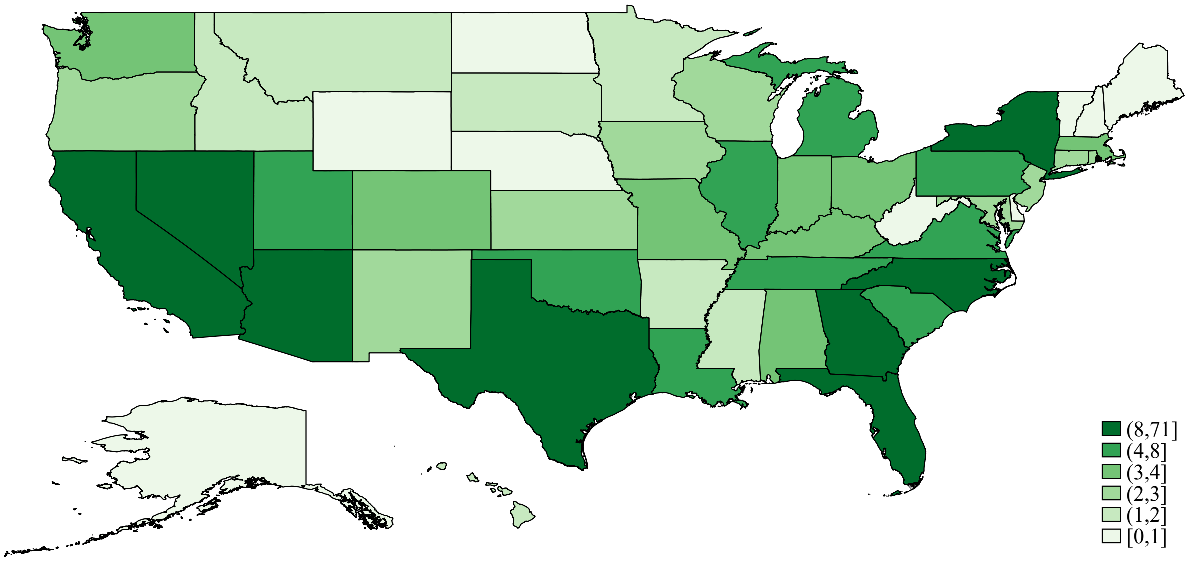
Figure A.1: Snapshot of Data Sources Scraped / Digitized



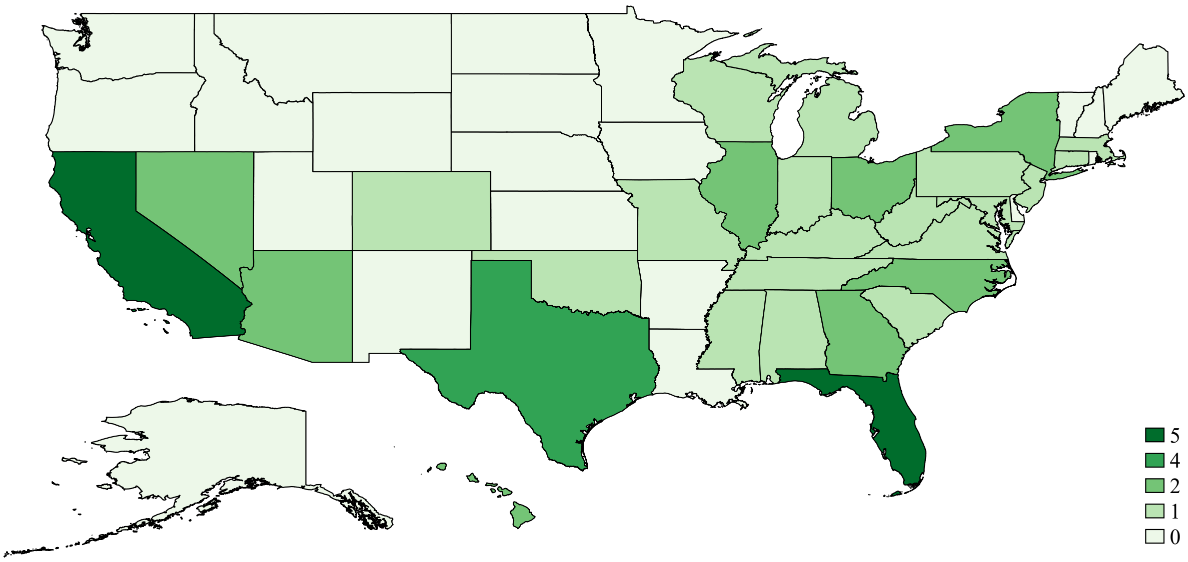
This figure is a snapshot of the data scraped from Golfstats and the data digitized from the PGA Tour Media Guides.

Figure A.2: The Location of Golfers and Tournaments

(a) Residence Location

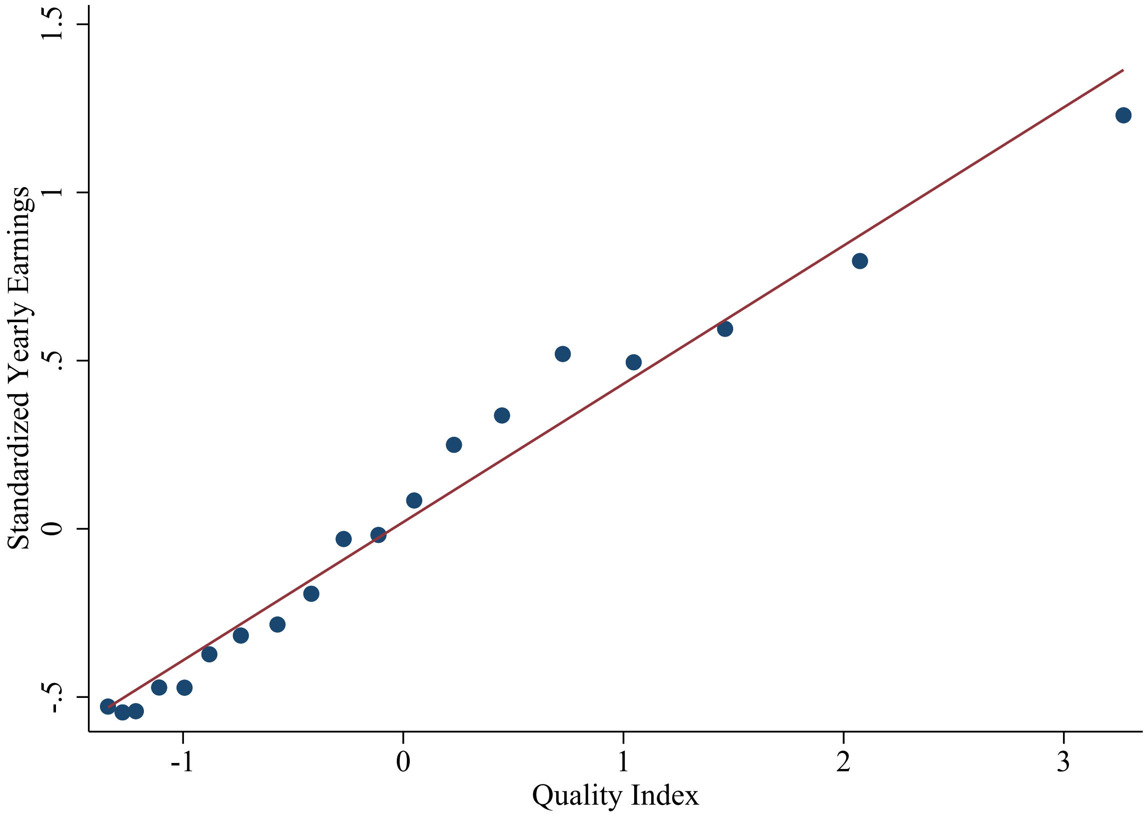


(b) Tournament Location



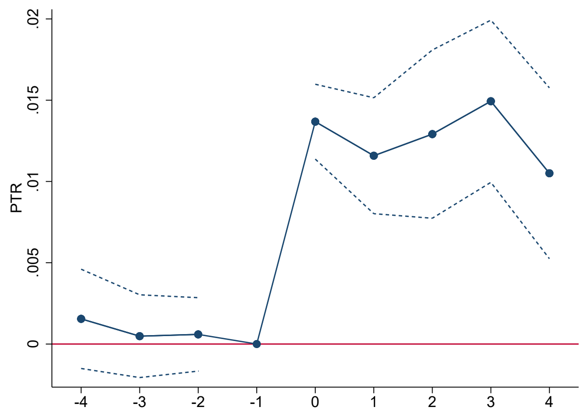
Part (a) shows the average number of residents in a year for a given state. Part (b) shows the average number of tournaments in a state for a given year, conditional on holding a tournament in that year.

Figure A.3: Correlation of Quality Index with Observed Performance

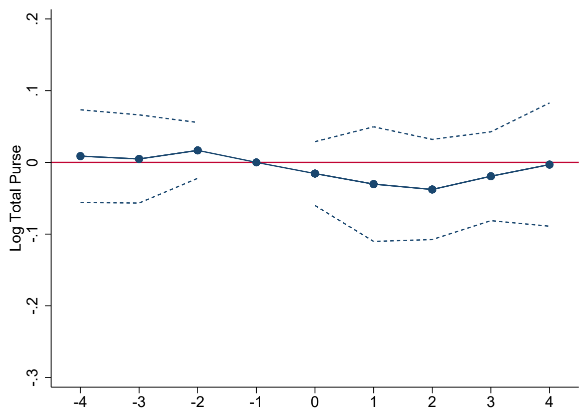


This figure is a visualization of the relationship between yearly earned income and our Lubotsky and Wittenberg (2006) data driven index of quality. To construct this figure, we standardize yearly income and the quality index such that they have a mean of zero and standard deviation of one. We then obtain grouped bins for yearly income and the index and plot a line of best-fit through the data.

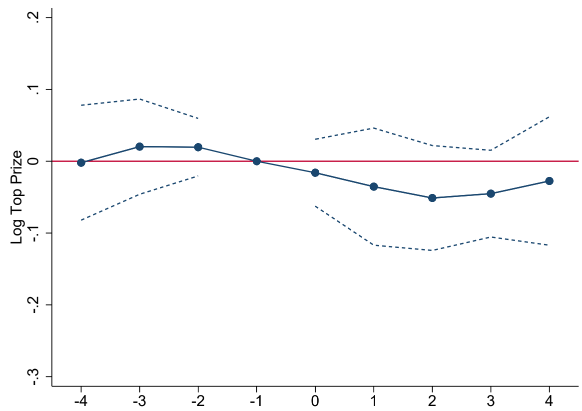
Figure A.4: Effect of Tax Changes on Earnings



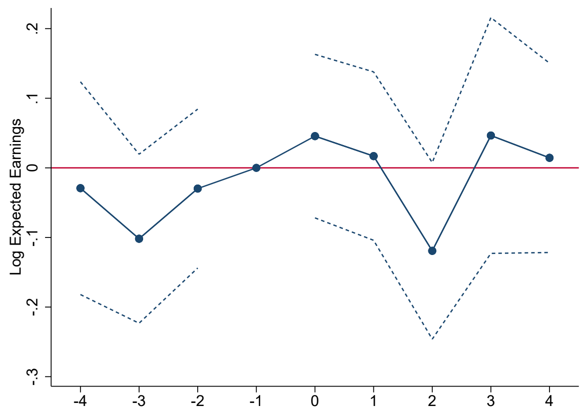
(a) Effect on Tax Rate



(b) Effect on Purse



(c) Effect on Top Prize

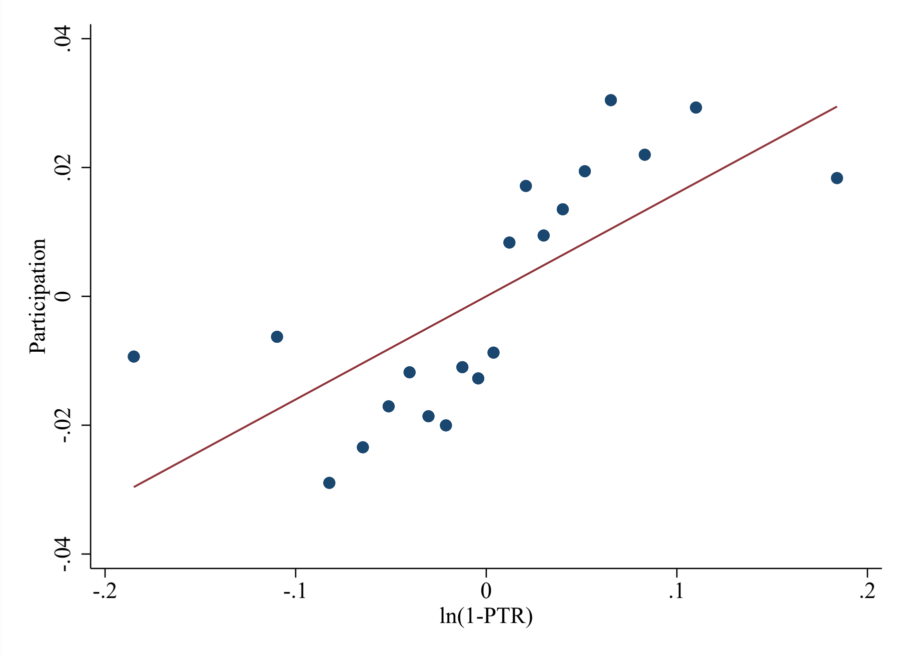


(d) Effect on Expected Earnings

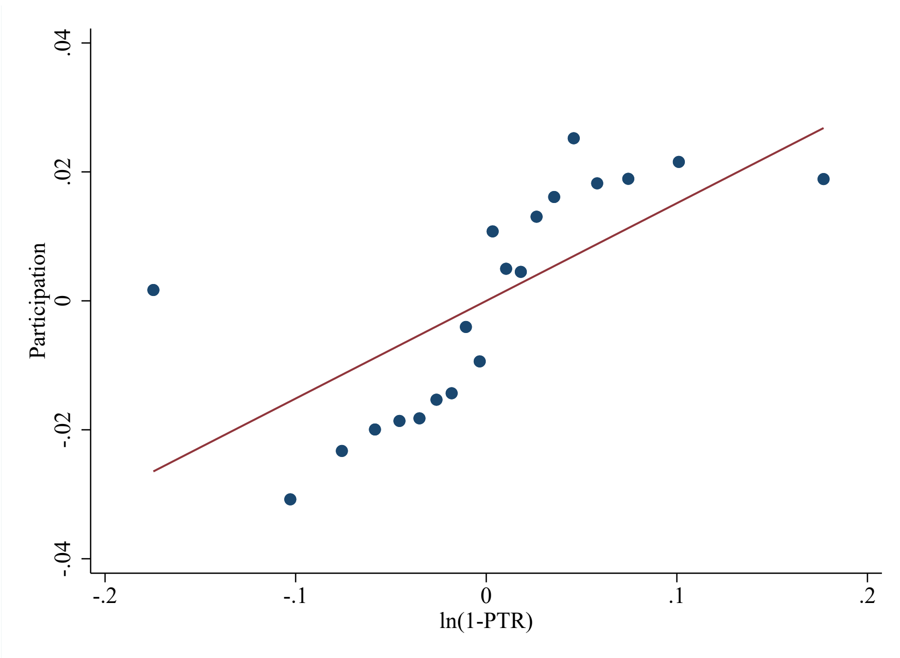
Using aggregate data by tournament-year, these figures show how the effect of major tax increase on various measures of golfer earnings. Panel (a) shows the first stage effect of a state tax increase on the tax rate. Panel (b) shows the effect on the purse size, panel (c) on the top prize, and panel (d) on our measure of expected earnings. In this instance, an event is defined as a major tax increase—a more than one percentage point increase in the mean (across golfers) participation tax rate at the state level. All figures are made using the stacked event study design with "clean controls." Event time -1 is the year before the reform. Standard errors are clustered at the tournament state level and we present 95% confidence bands

Figure A.5: The Effect of Net-of-PTR on Participation

(a) Lubotsky and Wittenberg (2006) Index



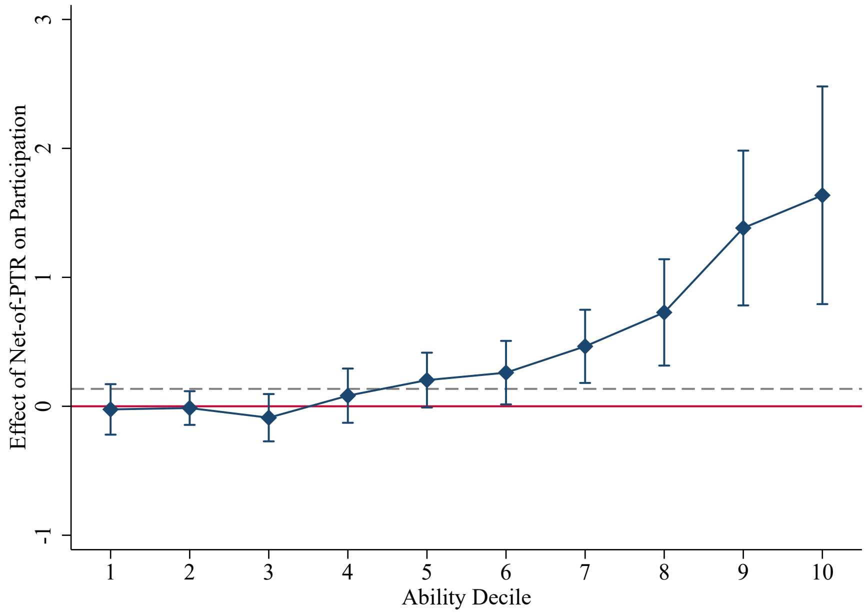
(b) Probit Index



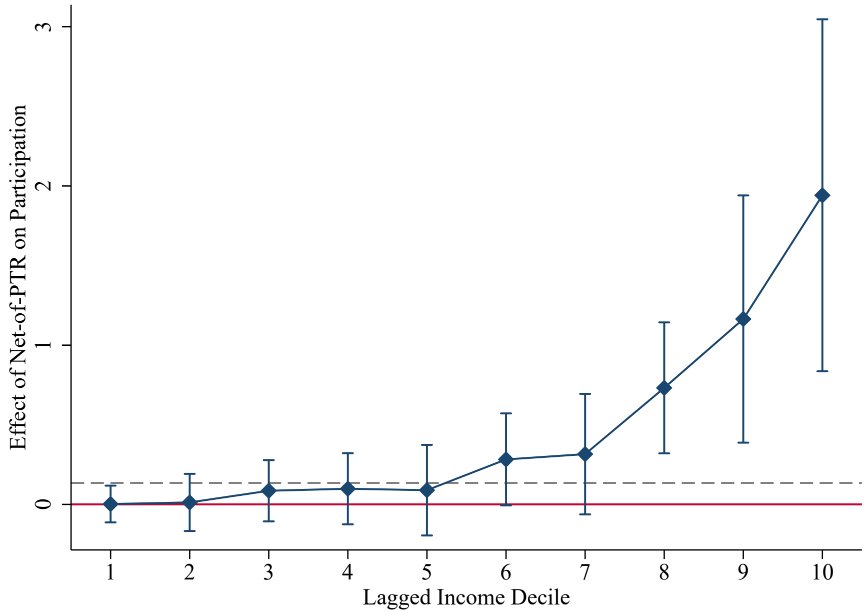
Panel (a) is a visualization of the regression of column 5 from Table 2 and Panel (b) is a visualization of the regression of column 5 from Table A.5. To construct this figure, we regress the year difference in participation on the fixed effects and controls and obtain the residuals. We do the same for the log of the net-of-PTR. We then bin the residuals and plot a line of best-fit through the data.

Figure A.6: Heterogeneity of the Effect of Taxes on Participation by Predicted Income and Quality Deciles: Fractional Probit

(a) Lagged Income Decile: Probit



(b) Quality Decile: Probit



This figure is similar to Figure 8. Instead of using actual earnings and the Lubotsky and Wittenberg (2006) index, we use a fractional probit model to predict earnings based on lagged characteristics of the golfer and construct a quality index. The PTR, expected earnings, and all fixed effects are interacted with indicators for the one year lag of predicted yearly income deciles from our probit model (panel a) and with indicators for the probit index deciles (panel b). We plot the marginal effect of an increase in the net-of-PTR for each decile. The grey dashed line represents the coefficient estimate from Table A.5 column 1. Standard errors are clustered at the golfer and state of tournament level and bars indicate 95% confidence intervals.

A.14 Additional Tables

Table A.1: Information on Golfer Moves

	Number	Share
PANEL A: GOLFER-YEAR OBSERVATIONS		
Does Not Move	9,896	97.09%
Moves from High to Low Tax State	127	1.25%
Moves from Low to High Tax State	102	1.00%
Moves to Similar Tax States	68	0.67%
Total Moves	297	2.91%
PANEL B: GOLFERS		
Golfers Who Move	189	23.95%
Age at Move	34.38	–

This table presents summary statistics on the residency changes of golfers observed in our sample. The tax determinations are done by comparing the average tax rate in the residence state in the year before the move to the average tax rate in the residence state in the year after the move.

Table A.2: Treatment Status by Tournament State

State	(1) Tax Increase	(2) Tax Increase Low-Tax Residency	(3) Tax Cut	(4) Tax Cut Low-Tax Residency
AL	0	0	0	0
AZ	139	111	132	70
CA	425	421	316	226
CO	0	0	0	0
CT	109	90	32	11
FL	241	0	223	0
GA	98	78	54	30
HI	136	128	72	48
IL	102	57	78	20
IN	0	0	0	0
KY	0	0	0	0
MD	36	21	33	17
MA	66	55	67	38
MI	57	45	48	22
MS	56	42	50	25
MO	0	0	0	0
NV	47	0	41	0
NJ	20	20	24	22
NY	154	148	101	91
NC	84	70	162	149
OH	148	139	68	44
OK	0	0	5	0
PA	21	12	19	16
SC	88	78	73	43
TN	39	0	31	0
TX	174	0	174	0
VA	23	22	24	10
WV	5	2	5	2
WI	77	73	33	29
Total	2345	1612	1865	913

This table presents the number of treated golfer-tournament events in each state (based on the location of the tournament) for various event studies. We present the number of treated events separately by tax increases and decreases as well as by separately if a golfer lives in a low-tax state (column 2 and 4). Low-tax is defined as the golfer not having positive tax liability in the residence state after paying taxes to the employment state. Therefore, the difference between column 1 and 2 and column 3 and 4 yields the number of golfers in a tournament that are treated due to the residency state rate changing.

Table A.3: Treatment Status by Tournament Year

State	(1) Tax Increase	(2) Tax Increase Low-Tax Residency	(3) Tax Cut	(4) Tax Cut Low-Tax Residency
1982	105	91	43	18
1983	105	74	15	10
1984	36	21	47	24
1985	15	14	28	21
1986	25	19	19	18
1987	122	65	245	83
1988	63	49	117	45
1989	54	45	35	19
1990	183	104	12	12
1991	104	71	38	19
1992	71	51	26	5
1993	107	88	22	8
1994	49	26	75	24
1995	9	9	163	54
1996	44	33	202	58
1997	39	39	12	12
1998	10	10	6	6
1999	40	40	13	11
2000	34	27	10	8
2001	42	38	41	9
2002	34	28	54	27
2003	113	67	9	9
2004	43	29	26	24
2005	197	62	38	13
2006	26	26	39	30
2007	33	21	29	17
2008	90	63	42	28
2009	247	188	22	15
2010	24	24	34	34
2011	84	84	17	17
2012	127	43	63	35
2013	24	19	103	38
2014	46	44	220	162
Total	2345	1612	1865	913

This table presents the number of treated golfer-tournament events in each year for various event studies. We present the number of treated events separately by tax increases and decreases as well as by separately if a golfer lives in a low-tax state (column 2 and 4). Low-tax is defined as the golfer not having positive tax liability in the residence state after paying taxes to the employment state. Therefore, difference column 1 and 2 and column 3 and 4 yields the number of golfers in a tournament that are treated due to the residency state rate changing.

Table A.4: The Effect of Taxes on the Location of Employment: Removing Individual-specific Effects to Construct Grouped Expected Income

	(1) Baseline	(2) Earnings > 0	(3) Excludes Cut	(4) Lagged Percentile 25th-75th	(5) Lagged Percentile 75th-100th
$\Delta\ln(w^{\mathbb{E}}_{dty})$	0.010	0.011	0.014	0.016	0.011
	(0.002)	(0.003)	(0.002)	(0.003)	(0.007)
$\Delta\ln(1-\text{PTR}_{ity})$	0.130	0.146	0.160	0.139	0.357
	(0.044)	(0.053)	(0.043)	(0.057)	(0.139)
$\frac{d\Delta\ln(1-\text{PTR})}{d\Delta\ln(1-\text{ATR})}$	0.326	0.367	0.314	0.364	0.558
	(0.021)	(0.028)	(0.021)	(0.030)	(0.053)
$\epsilon_{1-\text{PTR}}$	0.302	0.293	0.528	0.268	0.613
	[0.102, 0.503]	[0.085, 0.503]	[0.249, 0.804]	[0.053, 0.486]	[0.145, 1.082]
$\epsilon_{1-\text{ATR}}$	0.098	0.108	0.165	0.098	0.342
	[0.033, 0.167]	[0.031, 0.188]	[0.077, 0.257]	[0.019, 0.180]	[0.080, 0.621]
Observations	287,064	243,672	235,178	133,958	71,299

This table shows the results estimating equation (6). Expected earnings are constructed by regressing realized earnings for participants on individual and tournament fixed effects separately for each decile×year. We then subtract individual fixed effects from the predicted values to obtain expected earnings. Column 1 places no additional restrictions on the sample. Column 2 excludes golfers with zero earnings in the current period. Column 3 excludes golfers who fail to make the cut. Column 4 uses golfers in the 25th-75th percentile of earnings in the previous period, and column 5 uses golfers in the 75th-100th percentile of earnings in the previous period. Here, we do not perform the bootstrap procedure described in appendix A.7 due to the computational intensity required to compute standard errors on a different earnings expectation. Standard errors are clustered at the golfer and the state of the tournament level. Ninety-five percent confidence intervals on the elasticities are obtained using a parametric bootstrap.

Table A.5: The Effect of Taxes on the Location of Employment: Fractional Probit to Predict Earnings

	(1) Baseline	(2) Earnings > 0	(3) Excludes Cut	(4) Lagged Percentile 25th-75th	(5) Lagged Percentile 75th-100th
$\Delta\ln(w^{\mathbb{E}}_{dty})$	0.012	0.015	0.018	0.020	0.016
	(0.003)	(0.004)	(0.003)	(0.004)	(0.006)
$\Delta\ln(1-\text{PTR}_{ity})$	0.146	0.179	0.216	0.194	1.056
	(0.064)	(0.078)	(0.058)	(0.090)	(0.329)
$\frac{d\Delta\ln(1-\text{PTR})}{d\Delta\ln(1-\text{ATR})}$	0.468	0.575	0.442	0.645	0.916
	(0.030)	(0.034)	(0.031)	(0.046)	(0.058)
$\epsilon_{1-\text{PTR}}$	0.317	0.344	0.650	0.352	1.821
	[0.044,0.590]	[0.049,0.639]	[0.305,0.995]	[0.032,0.672]	[0.709,2.933]
$\epsilon_{1-\text{ATR}}$	0.148	0.198	0.287	0.227	1.669
	[0.020,0.279]	[0.028,0.371]	[0.133,0.448]	[0.020,0.438]	[0.645,2.730]
Observations	266,338	232,092	214,826	125,998	65,852

This table shows the results estimating equation (6), but using a measure of predicted earnings rather than quality to construct golfer expectations. We use a fraction probit model to predict earnings as described in the appendix. Column 1 places no additional restrictions on the sample. Column 2 excludes golfers with zero earnings in the current period. Column 3 excludes golfers who fail to make the cut. Column 4 uses golfers in the 25th-75th percentile of earnings in the previous period and column 5 uses golfers in the 75th-100th percentile of earnings in the previous period. Here, we do not perform the bootstrap procedure described in appendix A.7 due to the computational intensity required to compute standard errors on a different earnings expectation. Standard errors are clustered at the golfer and the state of the tournament level. Ninety-five percent confidence intervals on the elasticities are obtained using a parametric bootstrap.

Table A.6: The Effect of Taxes on the Location of Employment: No Tournament-by-Year Fixed Effects

	(1) Baseline	(2) Earnings > 0	(3) Excludes Cut	(4) Lagged Percentile 25th-75th	(5) Lagged Percentile 75th-100th
$\Delta \ln(w^{\mathbb{E}}_{dty})$	0.010	0.012	0.015	0.018	0.014
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)
	{0.003}	{0.004}	{0.003}	{0.005}	{0.005}
$\Delta \ln(1 - \text{PTR}_{ity})$	0.134	0.149	0.173	0.107	0.388
	(0.052)	(0.062)	(0.050)	(0.067)	(0.183)
	{0.065}	{0.074}	{0.063}	{0.092}	{0.123}
$\frac{d\Delta \ln(1-\text{PTR})}{d\Delta \ln(1-\text{ATR})}$	0.516	0.598	0.498	0.642	0.862
	(0.026)	(0.033)	(0.026)	(0.043)	(0.051)
	{0.062}	{0.065}	{0.062}	{0.084}	{0.109}
$\epsilon_{1-\text{PTR}}$	0.294	0.286	0.531	0.195	0.666
	[0.014,0.574]	[0.005,0.568]	[0.150,0.912]	[-0.133, 0.523]	[0.252,1.079]
$\epsilon_{1-\text{ATR}}$	0.152	0.171	0.265	0.125	0.574
	[0.007,0.308]	[0.003,0.350]	[0.072,0.477]	[-0.085,0.346]	[0.209,0.983]
Observations	269,807	232,138	218,087	127,195	66,893

This table shows the results estimating equation (6) excluding tournament by year fixed effects from the regression specification. Column 1 places no additional restrictions on the sample. Column 2 excludes those golfers with zero earnings in the current period. Column 3 excludes those golfers who fail to make the cut. Column 4 uses only golfers in the 25th-75th percentiles of earnings in the previous period, and column 5 uses only golfers in the 75th-100th percentiles of earnings in the previous period. Standard errors that are simply clustered at the golfer and the state of the tournament level are in parentheses, ( ), while bootstrapped standard errors are in braces, { }. Ninety-five percent confidence intervals on the elasticities are in brackets, [ ], and are obtained using a parametric bootstrap utilizing the latter standard errors.

Table A.7: The Effect of Taxes on the Location of Employment: By Tournament Order in a State

$\Delta \ln(1 - \text{PTR}_{ity})$	(1) Earnings > 0	(2) Lagged Percentile 75th-100th
Base specification	0.174 (0.077) {0.078}	0.462 (0.209) {0.139}
States with only one tournament	0.295 (0.102) {0.093}	0.895 (0.355) {0.241}
States with more than one tournament	0.118 (0.092) {0.079}	0.272 (0.246) {0.131}
First in state with more than one tournament	0.159 (0.078) {0.088}	0.252 (0.267) {0.168}
Not first in state with more than one tournament	0.099 (0.116) {0.082}	0.281 (0.269) {0.142}
Second in state with more than one tournament	0.092 (0.065) {0.091}	0.212 (0.134) {0.136}
States with more than two tournaments	0.114 (0.167) {0.108}	0.299 (0.343) {0.195}

This table shows the results estimating equation (6) except looking at differences based on the order of tournaments in the state and based on the number of tournaments in each state. Column 1 uses golfers with positive earnings and column 2 use those golfers in the 75th-100th percentile of earnings one period ago. Standard errors that are simply clustered at the golfer and the state of the tournament level are in parentheses, ( ), while bootstrapped standard errors are in braces, { }. Unfortunately, there are relatively few states with multiple tournaments, so sample sizes and the number of clusters in these latter rows are small, resulting in larger standard errors.

Table A.8: The Effect of Taxes on the Location of Employment: Controlling for Cumulative Participation

$\Delta \ln(1 - \text{PTR}_{ity})$	(1) Earnings > 0	(2) Lagged Percentile 75th-100th
Base specification	0.174 (0.066) {0.078}	0.462 (0.192) {0.139}
$\epsilon_{1-\text{PTR}}$	0.335 [0.042,0.628]	0.793 [0.371,1.214]
Controlling for cumulative earnings and participation	0.170 (0.059) {0.071}	0.549 (0.176) {0.126}
$\epsilon_{1-\text{PTR}}$	0.327 [0.058,0.596]	0.941 [0.519,1.363]
More than median number of tournaments	0.291 (0.115) {0.123}	0.390 (0.171) {0.155}
$\epsilon_{1-\text{PTR}}$	0.426 [0.061,0.684]	0.621 [0.126,1.043]
Less than median number of tournaments	0.195 (0.098) {0.110}	0.410 (0.235) {0.163}
$\epsilon_{1-\text{PTR}}$	0.291 [-0.030,0.613]	0.636 [0.139, 1.133]

This table studies whether the assumption of golfers making a one-time participation decision is reasonable. The first panel presents our baseline results for golfers with positive earnings (column 1) and top 25% golfers (column 2). The second panel shows results estimating equation (6) controlling for cumulative earnings and participation (e.g., total earnings and number of tournaments participated in up to tournament t). The third and fourth panels study effects before and after the golfer participates in their median (in time) tournament. Standard errors that are simply clustered at the golfer and the state of the tournament level are in parentheses, ( ), while bootstrapped standard errors are in braces, { }. Ninety-five percent confidence intervals on the elasticities are in brackets, [ ], and are obtained using a parametric bootstrap utilizing the latter standard errors.

Table A.9: The Heterogeneous Effect of Taxes by Tournament Quality

	(1) Baseline	(2) Earnings > 0	(3) Excludes Cut	(4) Lagged Percentile 25th-75th	(5) Lagged Percentile 75th-100th
$\Delta \ln(1-\mathrm{PTR}_{ity}) * Q_1$	0.218	0.237	0.252	0.195	0.555
	(0.058)	(0.070)	(0.061)	(0.091)	(0.205)
	{0.076}	{0.087}	{0.076}	{0.116}	{0.161}
$\Delta \ln(1-\mathrm{PTR}_{ity}) * Q_2$	0.214	0.246	0.261	0.224	0.766
	(0.074)	(0.087)	(0.075)	(0.094)	(0.241)
	{0.086}	{0.101}	{0.086}	{0.120}	{0.217}
$\Delta \ln(1-\mathrm{PTR}_{ity}) * Q_3$	0.130	0.156	0.171	0.099	0.464
	(0.061)	(0.068)	(0.059)	(0.081)	(0.238)
	{0.075}	{0.086}	{0.076}	{0.100}	{0.183}
$\Delta \ln(1-\mathrm{PTR}_{ity}) * Q_4$	0.047	0.052	0.095	0.001	0.017
	(0.059)	(0.068)	(0.068)	(0.088)	(0.133)
	{0.072}	{0.081}	{0.073}	{0.108}	{0.124}
ϵ_{Q_1}	0.493	0.472	0.803	0.348	1.230
	[0.156,0.831]	[0.133,0.813]	[0.330,1.276]	[-0.059,0.755]	[0.531,1.930]
ϵ_{Q_2}	0.464	0.466	0.800	0.397	1.289
	[0.095,0.833]	[0.091,0.841]	[0.286,1.315]	[-0.021,0.814]	[0.574,2.006]
ϵ_{Q_3}	0.283	0.296	0.521	0.177	0.768
	[-0.038,0.604]	[-0.023,0.615]	[0.067,0.976]	[-0.175,0.530]	[.172,1.364]
ϵ_{Q_4}	0.102	0.100	0.283	0.002	0.025
	[-0.205,0.409]	[-0.207,0.408]	[-0.140,0.707]	[-0.419,0.423]	[-0.329,0.378]
Observations	269,454	231,827	217,812	127,013	66,802

This table shows estimates of tournament quality quartiles fully interacted with equation (6). The quality quartiles are constructed using the percentiles of the purse for each tournament in each year. The best tournaments are in the fourth quartile. Column 1 places no additional restrictions on the sample. Column 2 excludes golfers with zero earnings in the current period. Column 3 excludes golfers who fail to make the cut. Column 4 uses golfers in the 25th-75th percentile of earnings in the previous period, and column 5 uses golfers in the 75th-100th percentile of earnings in the previous period. Standard errors that are simply clustered at the golfer and the state of the tournament level are in parentheses, ( ), while bootstrapped standard errors are in braces, { }. Ninety-five percent confidence intervals on the elasticities are in brackets, [ ], and are obtained using a parametric bootstrap utilizing the latter standard errors. For simplicity, we omit estimated of $\epsilon_{1-\mathrm{ATR}}$ in this table.