Data and Code for: "A fish cartel for Africa"

Gabriel Englander and Christopher Costello

Data and Code Availability Statement

The paper uses public, non-confidential data we collected on agreements that grant fishing access to African or Parties to the Nauru Agreement (PNA) waters. The archive contains the data in the folder "data/". The file is called 2. access.csv.

The paper uses public, non-confidential data from the World Bank on Consumer Price Indices. The archive contains the data in the folder "data/". The file is called API_FP.CPI.TOTL_DS2_en_csv_v2_3358502.xlsx. We downloaded the data on December 1, 2021 from https://data.worldbank.org/indicator/FP.CPI.TOTL.

The paper uses public, non-confidential data from the Pacific Islands Forum Fisheries Agency on PNA countries' access fee revenue. The archive contains the data in the folder "data/". The file is called Compendium of Economic and Development Statistics 2020.xlsx. We downloaded the data on September 23, 2021 from https://www.ffa.int/node/2596.

The paper uses data produced by the authors on ex-vessel prices of tuna in the year 2019. The archive contains the data in the folder "data/". The file is called exvessel_tuna_2019.csv. These data were produced by applying the method of Melnychuck et al. (2017; ICES Journal of Marine Science) to updated data from the Food and Agriculture Organization.

The paper uses public, non-confidential data on fishing vessels from Global Fishing Watch. The archive contains the data in the folder "data/". The file is called fishing-vessels-v2.csv. We downloaded the data on April 7, 2022 from https://globalfishingwatch.org/datasets-and-code/.

The paper uses public, non-confidential fishing activity data from Global Fishing Watch. The archive contains the data in the folder "data/mmsi-daily-csvs-10-v2". We downloaded the data on April 7, 2022 from https://globalfishingwatch.org/datasets-and-code/.

The paper uses data produced by the authors on the growth rates of fish stocks from Costello et al. (2016; PNAS). The archive contains the data in the folder "data/". The file is called Unlumped_ProjectionData.csv.

The paper uses public, non-confidential data from the Pacific Islands Forum Fisheries Agency on catch in PNA countries' waters. The archive contains the data in the folder "data/". The file is called Value of WCPFC-CA tuna fisheries 2022_0.xlsx. We downloaded the data on August 9, 2022 from https://www.ffa.int/node/2721.

The paper uses public, non-confidential data from the Sea Around US on catch in African and PNA countries' waters. The archive contains the data in the folder "data/SAU/". We downloaded the data on African

and PNA countries on May 9, 2022 and August 9, 2022, respectively, from https://www.seaaroundus.org/data/#/eez. Replicators who wish to re-download the raw data must manually click on each country, and then click "Download Data" for that country.

The paper uses public, non-confidential boundary data of countries' Exclusive Economic Zones from the Flanders Marine Institute (Flanders Marine Institute, 2019). The archive contains the data in the folder "data/World_EEZ_v11_20191118". We downloaded the data on September 23, 2021 from https://www.marineregions.org/downloads.php.

Computational Requirements

Software and Hardware Requirements

-Software: R. We used Version 4.1.0, but other versions should work too, especially those >= 4.1.0.

You may also need to install Rtools 4.0: https://cran.r-project.org/bin/windows/Rtools/rtools40.html

-Packages: There are many of them. They are all recorded in renv.lock file. When you run Scripts/RUN THIS FIRST.R, the renv package will automatically install all of them.

-OS: We used Windows 10. Other versions of Windows, as well as Mac and Linux, should work too.

-CPU: We have Intel(R) Core(TM) i7-8565U CPU @ 1.80GHz 1.99 GHz

-Installed RAM: 8 GB

Description of programs/code

-RUN THIS FIRST.R installs all required R packages

-files in scripts/make_data folder make the object(s) described in the title of the script. For example, calculate_avg_eu_fee_ton.R creates the object avg_eu_fee_ton.Rdata (the average access fee paid by the European Union).

-policy_function_and_simulation_african_continent.R performs the main analysis of the paper and outputs the results.

-policy_function_and_simulation_african_regional.R considers the case of regional African selling coalitions (rather than a continent-level coalition) and outputs the results.

-policy_function_and_simulation_pna.R applies the model to the case of the Parties to the Nauru Agreement (PNA) countries' market and outputs the results.

-percent_nonaccess_domestic.R calculates the % of non-access catch that is domestic, as opposed to unauthorized foreign.

-files in scripts/robustness_checks perform the robustness check indicated by the file name. For example, policy_function_and_simulation_african_bbmsy_point4.R re-runs the model when selling countries' status quo biomass relative to biomass at maximum sustainable yield is 0.4 (instead of the main specification's value of 0.8).

-files in scripts/make_figures create the figure(s) listed in the script name. For example, plot_figure2_S17_S18 creates Figures 2, S17, and S18.

-files in scripts/make_tables create the table(s) listed in the script name. For example, make_table1.R creates Table 1

Downloading and opening the replication files

Download the four parts of the reproducibility package first and then unzip part 1 (*RR_AFR_2023_17-v01.zip*). This file contains the folder structure in which you should unzip the remaining parts of the reproducibility package. Then unzip the contents of the three remaining parts in the folder `data/mmsi-daily-csvs-10-v2` to replicate the full folder and file structure.

After that, open RStudio, click File -> Open Project, find access.Rproj among the files on your computer, and click Open. If you are cloning the repository from Github (https://github.com/englander/access), open RStudio, click File -> New Project -> Version Control -> Git, paste "https://github.com/englander/access.git", and click Create Project.

Installing specific package versions

First, run Scripts/RUN THIS FIRST.R. That script will install all R packages you need. It installs the same package versions we used to facilitate reproducibility.

Data preparation

Run the scripts in scripts/make_data folder first. calculate_gt_africa.R takes about 45 hours to run, but this time can be reduced by increasing the number of cores used on line 152 (choose a number larger than 4, depending on the number of cores of your machine, in plan(multisession, workers = 4)). calculate_gt_pna.R takes about 1.5 hours to run, make_pairwise_buyer_african_seller_hours_df.R takes about 18 hours to run, and make_pairwise_buyer_pna_seller_hours_df.R takes about 7 hours to run (these run times can also be reduced by increasing the number of cores used in plan(multisession, workers = 4)). The remaining scripts take about 10 minutes to run in total.

Analysis

Next run the three policy_function_and_simulation_* scripts. These scripts take 1 hour to run in total.

Then run the policy_function_and_simulation_* scripts in scripts/robustness_checks folder. These scripts take 2 hours to run in total.

Running scripts in scripts/make_figures folder will reproduce figures in the paper, and running scripts in scripts/make_tables will reproduce tables in the paper. Scripts in either of these folders are fast to run, requiring no more than a few minutes each.

Output-Exhibit Correspondence

For figures whose output names are not Figure 1 etc.

- Fig 2a-d = access_harvest_percent_diff.png, pi_percent_diff.png, total_harvest_percent_diff.png, and biomass_percent_diff.png, respectively.
- Fig S3a-d = access_harvest_sq_twice_baseline_threshold.png, access_harvest_percent_diff_twice_baseline_threshold.png, pi_sq_twice_baseline_threshold.png, pi_percent_diff_twice_baseline_threshold.png, respectively.
- Fig S4a-d = total_harvest_sq_twice_baseline_threshold.png, total_harvest_percent_diff_twice_baseline_threshold.png, biomass_tons_sq_twice_baseline_threshold.pr biomass_percent_diff_twice_baseline_threshold.png, respectively.
- Fig S5a-d = access_harvest_sq_bbmsy_point6.png, access_harvest_percent_diff_bbmsy_point6.png, pi_sq_bbmsy_point6.png, pi_percent_diff_bbmsy_point6.png, respectively.
- Fig S6a-d = total_harvest_sq_bbmsy_point6.png, total_harvest_percent_diff_bbmsy_point6.png, biomass_tons_sq_bbmsy_point6.png, biomass_percent_diff_bbmsy_point6.png, respectively.
- Fig S7a-d = access_harvest_sq_bbmsy_point4.png, access_harvest_percent_diff_bbmsy_point4.png, pi_sq_bbmsy_point4.png, pi_percent_diff_bbmsy_point4.png, respectively.
- Fig S8a-d = total_harvest_sq_bbmsy_point4.png, total_harvest_percent_diff_bbmsy_point4.png, biomass_tons_sq_bbmsy_point4.png, biomass_percent_diff_bbmsy_point4.png, respectively.
- Fig S9a-d = access_harvest_sq_eta_point5.png, access_harvest_percent_diff_eta_point5.png, pi_sq_eta_point5.png, pi_percent_diff_eta_point5.png, respectively.
- Fig S10a-d = total_harvest_sq_eta_point5.png, total_harvest_percent_diff_eta_point5.png, biomass_tons_sq_eta_point5.png, biomass_percent_diff_eta_point5.png, respectively.
- Fig S11a-d = access_harvest_sq_eta_1point5.png, access_harvest_percent_diff_eta_1point5.png, pi_sq_eta_1point5.png, pi_percent_diff_eta_1point5.png, respectively.

- Fig S12a-d = total_harvest_sq_eta_1point5.png, total_harvest_percent_diff_eta_1point5.png, biomass_tons_sq_eta_1point5.png, biomass_percent_diff_eta_1point5.png, respectively.
- Fig S13a-d = access_harvest_sq_epsilon_1point5.png, access_harvest_percent_diff_epsilon_1point5.png pi_sq_epsilon_1point5.png, pi_percent_diff_epsilon_1point5.png, respectively.
- Fig S14a-d = total_harvest_sq_epsilon_1point5.png, total_harvest_percent_diff_epsilon_1point5.png, biomass_tons_sq_epsilon_1point5.png, biomass_percent_diff_epsilon_1point5.png, respectively.
- Fig S15a-d = access_harvest_sq_epsilon_2point5.png, access_harvest_percent_diff_epsilon_2point5.png pi_sq_epsilon_2point5.png, pi_percent_diff_epsilon_2point5.png, respectively.
- Fig S16a-d = total_harvest_sq_epsilon_2point5.png, total_harvest_percent_diff_epsilon_2point5.png, biomass_tons_sq_epsilon_2point5.png, biomass_percent_diff_epsilon_2point5.png, respectively.
- Fig S17a-d = access_harvest_sq.png, pi_sq.png, total_harvest_sq.png, biomass_tons_sq.png, respectively.
- Fig S18a-b = non_access_harvest_sq.png, non_access_harvest_percent_diff.png
- Fig S20a-d = access_harvest_sq_regional.png, access_harvest_percent_diff_regional.png, pi_sq_regional.png, pi_percent_diff_regional.png, respectively.
- Fig S21a-d = total_harvest_sq_regional.png, total_harvest_percent_diff_regional.png, biomass_tons_sq_regional.png, biomass_percent_diff_regional.png, respectively.
- Fig S22a-d = pna_access_harvest_sq_thousands.png, pna_access_harvest_percent_diff.png, pna_pi_sq_millions.png, pna_pi_percent_diff.png, respectively.
- Fig S23a-d = pna_total_harvest_sq_thousands.png, pna_total_harvest_percent_diff.png, pna_biomass_tons_sq_millions.png, pna_biomass_percent_diff.png, respectively.
- Fig S24a-d = pna_access_harvest_sq_thousands_half_access_catch.png, pna_access_harvest_percent_diff_half_access_catch.png, pna_pi_sq_millions_half_access_catch.png, pna_pi_percent_diff_half_access_catch.png, respectively.
- Fig S25a-d = pna_total_harvest_sq_thousands_half_access_catch.png, pna_total_harvest_percent_diff_half_access_catch.png, pna_biomass_tons_sq_millions_half_access_ pna_biomass_percent_diff_half_access_catch.png, respectively. Fig S26a-d = pna_access_harvest_sq_thousandsbbmsy_1point3.png, pna_access_harvest_percent_diffbbmsy_1point3.png, pna_pi_sq_millionsbbmsy_1point3.png, pna_pi_percent_diffbbmsy_1point3.png, respectively. Fig S27a-d = pna_total_harvest_sq_thousandsbbmsy_1point3.png, pna_total_harvest_percent_diffbbmsy_1point3.p pna_biomass_tons_sq_millionsbbmsy_1point3.png, pna_biomass_percent_diffbbmsy_1point3.png, respectively.

References

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