The Costs of Counterparty Risk in Long Term Contracts Code Guide - Section 2

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Overview

This file provides a detailed overview of the code structure for the numerical methods exercise. It is intended to guide future contributors through the logic, organization, and rationale of each section and function.

Contents

1 Cumulative Supply Functions: G_k and G_Q

This section computes and visualizes the cumulative supply functions for capacity and production, sorted by increasing average cost. These functions are fundamental for understanding the cost structure of Spain's wind and solar energy supply in 2022 and for subsequent market and policy analysis.

1.1 Purpose and Rationale

Purpose: To build the supply curve for renewable projects, showing how much capacity (MW) or production (MWh) is available at or below each cost level.
Why:

- Visualizes the distribution of costs across all projects.
- Enables equilibrium and scenario analysis by linking cost to cumulative supply.
- Allows comparison between solar and wind technologies.

1.2 How: Step-by-Step Process

1. Global Cumulative Functions We first compute cumulative capacity and production for all projects, sorted by average cost:

Listing 1: Global cumulative capacity and production

```
G_k <- wind_solar_proj_2022 |>
  arrange(avg_cost_euro_mwh) |>
  group_by(avg_cost_euro_mwh) |>
  summarise(cumulative_capacity = sum(capacity)) |>
  mutate(cumulative_capacity = cumsum(cumulative_capacity)) |>
  ungroup()

G_Q <- wind_solar_proj_2022  |>
  arrange(avg_cost_euro_mwh) |>
  group_by(avg_cost_euro_mwh) |>
  summarise(cumulative_production = sum(q_i_mwh)) |>
  mutate(cumulative_production = cumsum(cumulative_production)) |>
  ungroup()
```

2. Technology-Specific Supply Curves We then compute separate supply curves for solar and wind projects, using loops to calculate cumulative capacity at each unique cost point:

Listing 2: Cumulative capacity for solar and wind

```
solar_proj_2022 <- wind_solar_proj_2022  |>
  filter(type == "Solar") |>
  arrange(avg_cost_euro_mwh)

G_k_solar <- data.frame(avg_cost_euro_mwh = numeric(),
                        cumulative_capacity = numeric())

for (cost in unique(solar_proj_2022$avg_cost_euro_mwh)) {
  cumulative_capacity <- sum(solar_proj_2022$capacity[solar_proj_2022$
     avg_cost_euro_mwh
                                                      <= cost])
  G_k_solar <- rbind(G_k_solar,
```

```
                    data.frame(avg_cost_euro_mwh = cost,
                               cumulative_capacity = cumulative_
                                  capacity))
}
G_k_solar$type <- 'Solar'

wind_proj_2022 <- wind_solar_proj_2022  |>
  filter(type == "Wind") |>
  arrange(avg_cost_euro_mwh)

G_k_wind <- data.frame(avg_cost_euro_mwh = numeric(),
                       cumulative_capacity = numeric())

for (cost in unique(wind_proj_2022$avg_cost_euro_mwh)) {
  cumulative_capacity <- sum(wind_proj_2022$capacity[wind_proj_2022$avg
     _cost_euro_mwh
                                                     <= cost])
  G_k_wind <- rbind(G_k_wind,
                    data.frame(avg_cost_euro_mwh = cost,
                               cumulative_capacity = cumulative_
                                  capacity))
}
G_k_wind$type <- 'Wind'

G_k_solar_and_wind <- rbind(G_k_wind, G_k_solar)
```

3. Visualization: Supply Curve Plot We create a step plot of the supply curve, showing how cumulative capacity increases as higher-cost projects are included:

Listing 3: Plotting the cumulative supply curve

```
G_k_all <- wind_solar_proj_2022 |>
  arrange(avg_cost_euro_mwh) |>
  group_by(avg_cost_euro_mwh) |>
  summarise(capacity = sum(capacity, na.rm = TRUE)) |>
  ungroup() |>
  mutate(cumulative_capacity = cumsum(capacity))

avg_cost_vs_cum_cap <- ggplot(G_k_all,
                              aes(x = cumulative_capacity,
                                  y = avg_cost_euro_mwh)) +
  geom_point(size = 8,
             shape = 17,
             alpha = 0.5,
             color = theme_palette_avg_cost_graphs) +
  geom_step(alpha = 0.3,
            size = 0.5,
            linetype = "solid",
            color = theme_palette_avg_cost_graphs) +
  labs(
    x = "Cumulative Capacity (MW)",
    y = "Avg. Cost (EUR/MWh)"
  ) +
  theme_minimal(base_size = base_s)

avg_cost_vs_cum_cap
```

```r
plot_filename <- paste0("solar_wind_avg_cost_cumulative_capacity", file
    _suffix, ".pdf")

plot_path_cpr <- file.path(out_figures, plot_filename)

# Save the plot
ggsave(
  filename = plot_path_cpr,
  plot = avg_cost_vs_cum_cap,
  width = 16,
  height = 9,
  dpi = 300
)
```

1.3 Interpretation and Output

- The step plot shows the supply curve: each step represents the addition of new capacity at a higher cost.
- The color and style are consistent with the project's theme, ensuring clarity for presentations or publications.
- The PDF output is saved in the designated figures folder for easy sharing and reproducibility.

In summary: This section constructs the essential supply curves for Spain's 2022 wind and solar projects, both in aggregate and by technology. These curves are foundational for understanding cost distributions, market potential, and for running subsequent policy or market simulations. The Figure 1 shows the average cost (€/MWh) for the cumulative capacity of the projects.

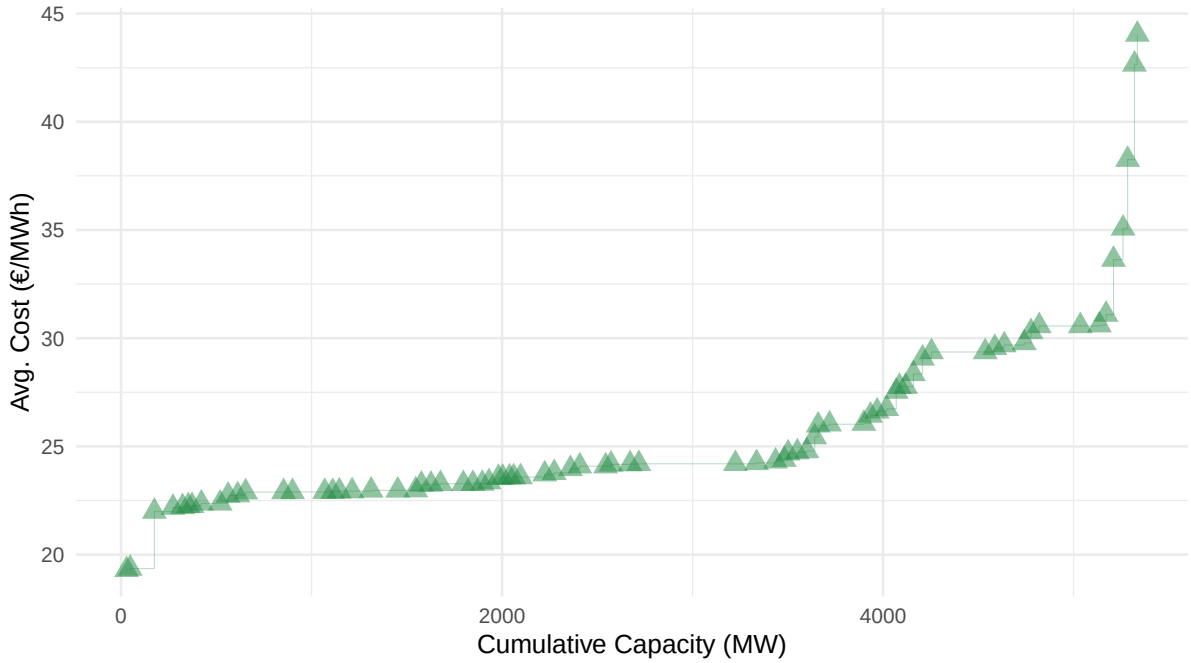

Figure 1: Average Cost (€/MWh)