The Costs of Counterparty Risk in Long-Term Contracts

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Joint work with Gerard Llobet (cemfi)

EEA-ESSEM Congress

Rotterdam, August 2024

The key role of the power sector

Decarbonizing power is critical to addressing climate change

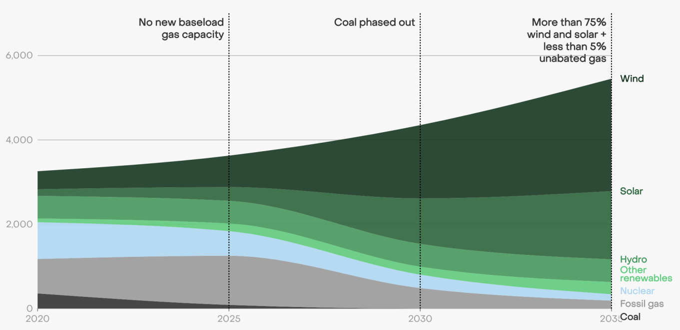

Figure: 1.5C pathways to clean power by 2035 in Europe

Decarbonizing power requires massively investing in renewables

Source: Ember

Is there a market failure?

Market failures:

1. Environmental externality Fabra and Reguant, 2024; Borenstein and Kellogg, 2023; Elliot, 2024...
2. Security of supply externality Fabra, 2018; Llobet and Padilla, 2018...
3. Market power Fabra and Llobet, 2023, 2024; Fioretti et al, 2024; Andrés-Cerezo and Fabra, 2023...

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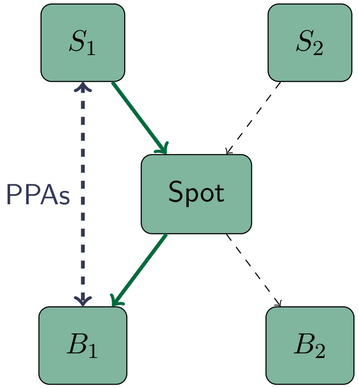
This paper: We uncover **counterparty risk** in long-term contracts as a major market failure that **increases the costs of renewable producers** and gives rise to **underinvestment** in renewable energies.

Long-term contracts in electricity markets

Power Purchase Agreements (PPA)

- **Financial bilateral contracts** between a seller (e.g., renewable firm) and a buyer (e.g., large consumer or power utility) at a fixed price.
- Sellers can use PPAs to **reduce their risk profile**, and can use them as collateral when financing their investments.
- Buyers can use PPAs to reduce price exposure, and **secure green sources of energy**, useful for regulatory and CSR purposes.



The Market for PPAs

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2. **New capacity** is provided by a unit mass of **(entrant) sellers (S)**, who can
   - build one unit of capacity,
   - allowing to produce one unit of the good at a marginal cost 0.
   - They have heterogeneous *i.i.d.* investment costs, $c \in [0, 1] \sim G(c)$,
   - plus a **risk premium** $r > 0$ if they invest under uncertainty.

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Entry is welfare improving if *Investment Costs* $<$ *MC savings*, i.e., $c < E[p]$.

(We are abstracting from other externalities)

The Model (cont.)

Timing of the game:

1. Investment stage: Entrants observe their c and decide whether to enter.
   Marginal costs of existing capacity p are realized
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- **Welfare loss**: risk premia + underivestment

$$W^{FB} - W^0 = rG\left(E(p) - r\right) + \int_{E(p)-r}^{E(p)} \left(E(p) - c\right) g\left(c\right) dc > 0.$$

Fixed-price contracts (no counterparty risk)

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- A fraction $\theta \in [0, 1]$ of **buyers** find it costless to trade; the remaining $(1 - \theta)$ buyers face a transaction cost sufficiently high that they never participate [endogenized later].

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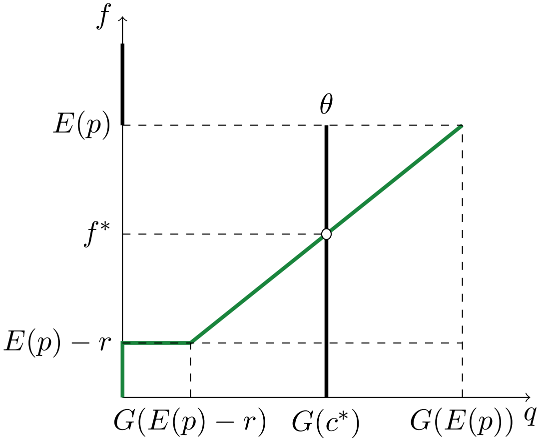
- **Buyers'** participation constraint: $f \leq E(p)$.
- **Sellers'** participation constraint: $f \geq E(p) - r$ and $f \geq c$.

Equilibrium in the contract market (no counterparty risk)



(a) Underinvestment because θ is low

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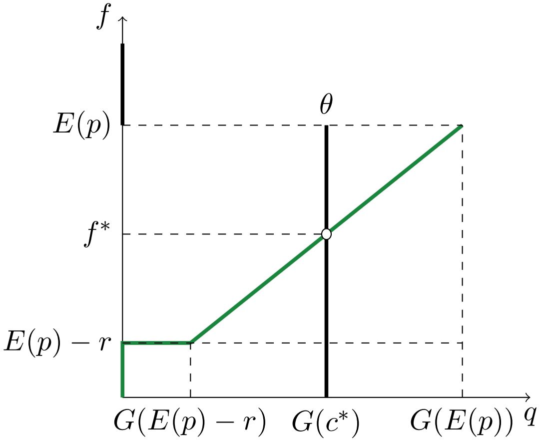

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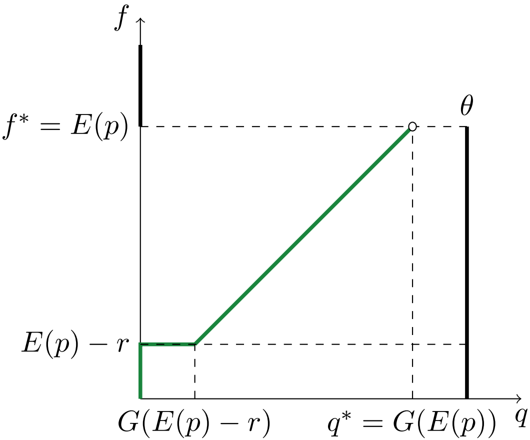

(b) Increasing θ allows for efficient investment

Adding buyers' counterparty risk

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$$\Pi_B(f) = v - f(1 - \Phi(f)) - \int_0^f p\phi(p)dp,$$

$$\Pi_S(f; c) = f(1 - \Phi(f)) + \int_0^f p\phi(p)dp - r\Phi(f) - c.$$

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- Buyers are always willing to participate in the contract.
- Sellers require $f \geq \underline{f}$, where $\Pi_S(\underline{f}; c) = E[p] - r - c$.

Sellers' profits under buyers' counterparty risk

- The sellers' **profit function is concave** due to a trade-off:
  - A higher f increases revenue, but also increases the probability of default.

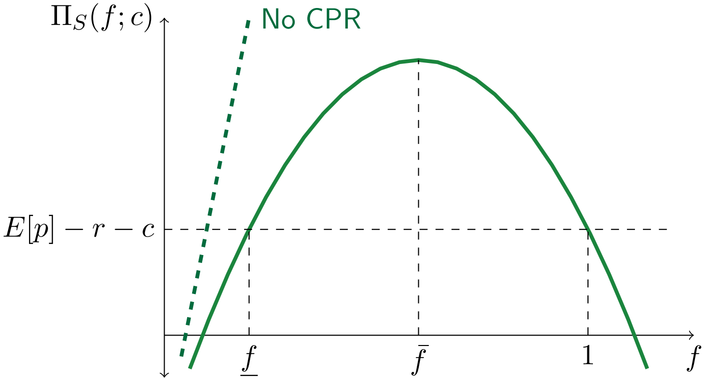

Figure: Seller's profits under a fixed-price contract as a function of f.

Deriving the Supply of Contracts

1. **Low-cost entrants** $c \leq E[p] - r$ invest regardless of whether they have a contract but require $\underline{f} > c$.
2. **Higher-cost entrants** invest only with a contract that allows them to break even, $\Pi_S(f; c) \geq 0$.
3. **Entry** with costs $c > \bar{c}$, where $\Pi_S(\bar{f}; \bar{c}) = 0$, **is never profitable**.

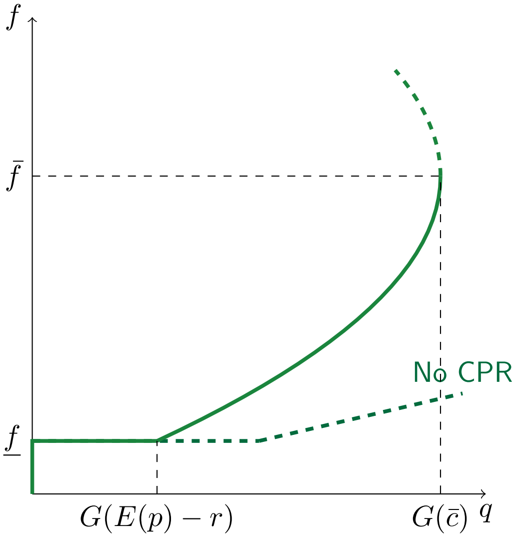

Figure: The supply of contracts

Contract Market Equilibrium

The no contract-rationing case

Consider **low contract demand** θ:

- Contracts allow for **investments** that would not have occurred without.
- Counterparty risk **raises the equilibrium price** to $f^* > c^*$,
- ...resulting in **inefficiencies** as all sellers face higher costs due to higher **risk premia** $\Phi(f^*)r$.

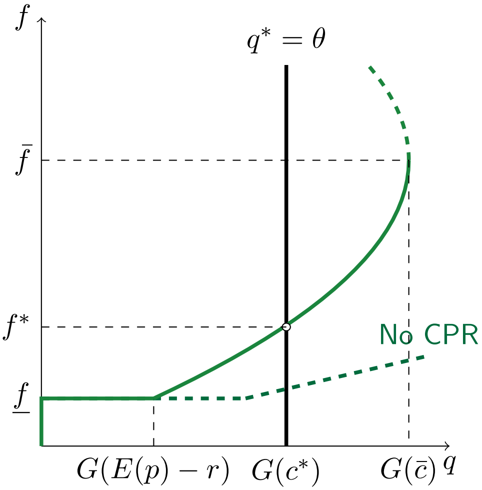

Figure: The no contract-rationing case

Contract Market Equilibrium

The inefficient contract-rationing case

Consider **higher demand** θ:

- Contracts give rise to **inefficient rationing** as there are no investments for $c > \bar{c}$.
- The equilibrium price maximizes sellers' profits, $f^* = \bar{f}$,
- ...resulting in the highest possible **risk premia** $\Phi(\bar{f})r$.

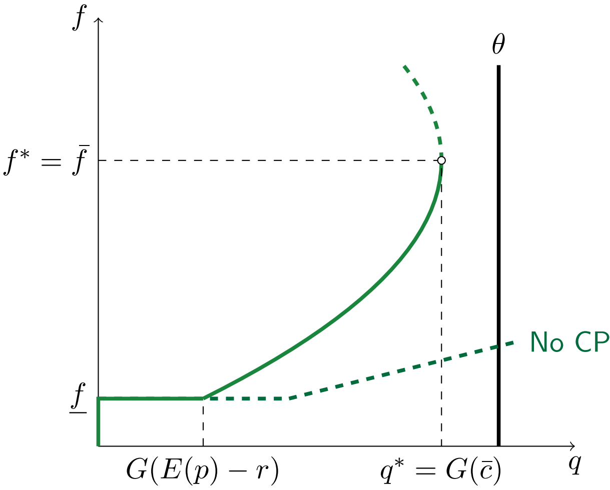

Figure: The inefficient contract-rationing case

Contracts are welfare-improving but do not eliminate all inefficiencies

Proposition

With counterparty risk and $r > 0$,

1. **Fixed-price contracts increase welfare** *relative to the no-contracts case, reducing sellers' risk exposure and underinvestment.*

$$W^* - W^0 = (1 - \Phi(f^*))rG(E[p] - r) + \int_{E[p]-r}^{c^*} [E(p) - \Phi(f^*)r - c]\, g(c)\, dc > 0.$$

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2. *With fixed-price contracts, sellers' risk premia and underinvestment are not fully eliminated, implying* **lower welfare than under the First Best** *(even if* $\theta = 1$*).*

$$W^{FB} - W^* = r\Phi\left(f^*\right)G(c^*) + \int_{c^*}^{E(p)} (E(p) - c)\, g\left(c\right) dc > 0.$$

Endogenizing contract demand through (costly) collateral

Counterparty risk is at the core of low contract demand:
sellers require collateral, which not all buyers can provide.

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- The per-unit **cost of collateral** k is $\rho \in [0, 1]$ (heterogeneous buyers).
- The **demand** for contracts shifts in, and becomes **downward sloping**.
- Sellers' profits increase, so the supply shifts out.
- The probability of default is zero for $f \leq k$, but positive for $f > k$.

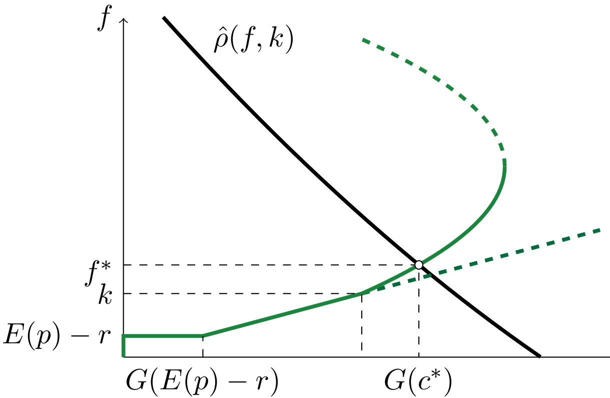

Figure: Market clearing with collateral k

Contract market equilibrium with costly collateral

Collateral mitigates the market failures, but does not fully address them.

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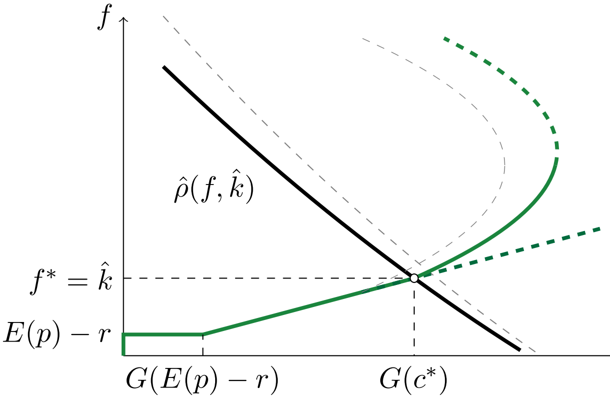
- To eliminate counterparty risk in equilibrium, $k \geq \hat{k}$ has to be large enough, resulting in a low f^*.

If r is low enough:

- Either such a low price is not feasible: sellers' prefer to trade in the spot market.
- Or sellers are better off with $k < \hat{k}$ to avoid the price reduction.

⇒ In equilibrium, **some counterparty risk remains**.



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Concluding Remarks

1. We build a novel & simple framework to analyze the effects of long-term contracting.
2. We uncover **buyers' counterparty risk** as a major **market failure** reducing the efficiency of private long-run contracting.
3. We assess **public policies to overcome this market failure**.

Counterparty risk in long-term contracting arises in other sectors, but becomes particularly relevant in the context of the Energy Tranistion

ENERGYECOLAB

Thank You!

Questions? Comments?

More info at nfabra.uc3m.es and energyecolab.uc3m.es

This Project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 772331)

Backup Slides

The Market for PPAs

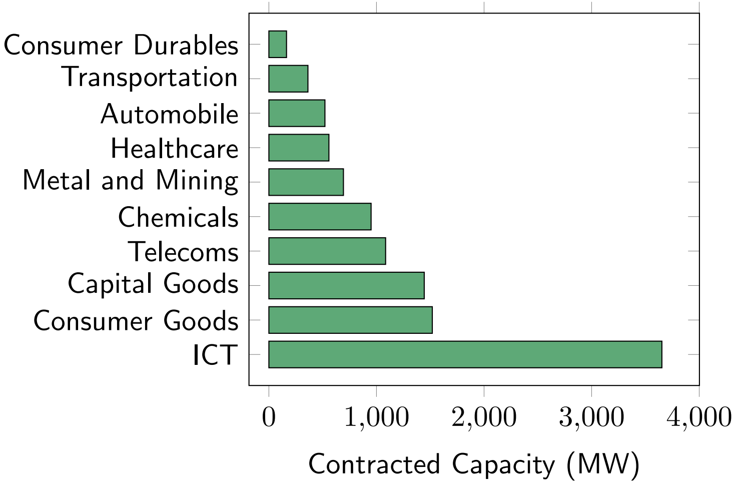

Figure: Volume of PPA contracts in Europe by Industry in 2023

The Market for PPAs

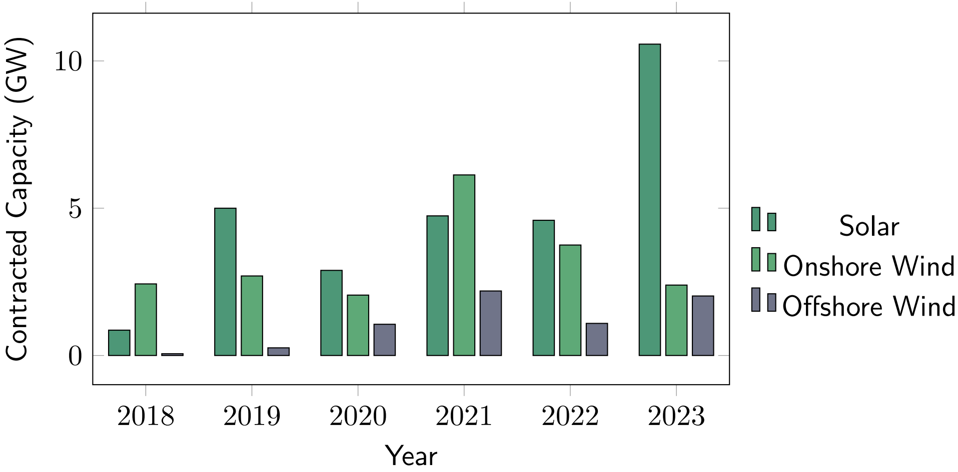

Figure: Volume of PPA Contracts by Technology in Europe

Source: Pexapark

The Market for PPAs

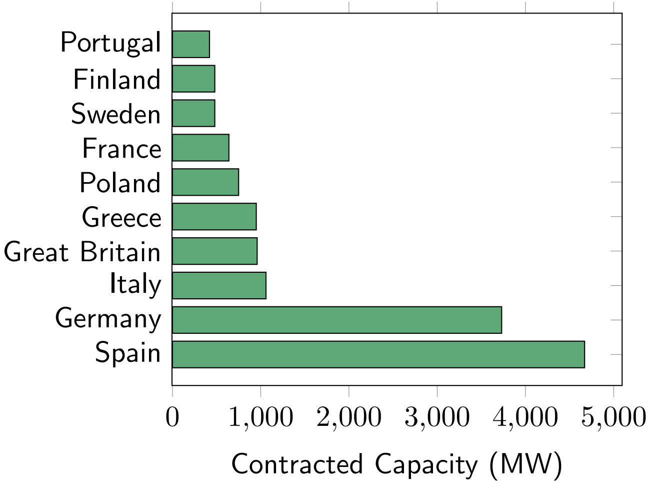

Figure: Volume of PPA contracts in Europe by Country in 2023

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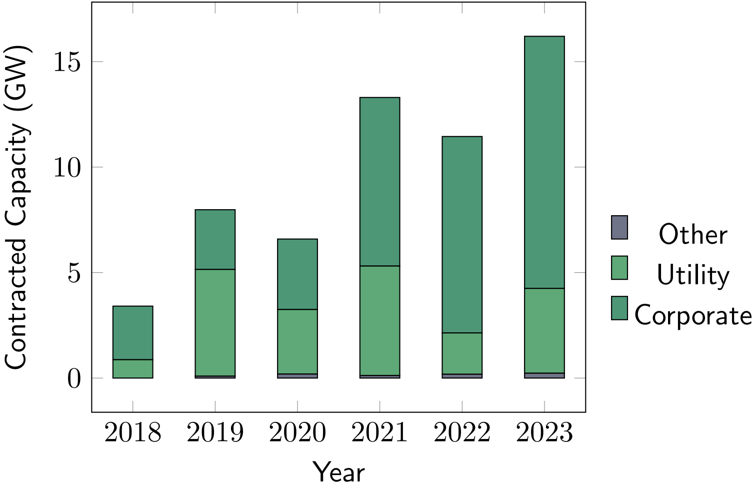

Figure: Volume of PPA contracts in Europe by Type of Buyer and Year

A Market for (Near) Futures Return

Country	Maximum Maturity of Power Futures
Germany	10 years
Italy	10 years
Spain	10 years
France	6 years
Japan	6 years
Nordics (Denmark, Sweden, Norway, Finland)	6 years
Netherlands	6 years
United Kingdom	2 years

Table: Maximum Maturity of Power Futures Markets by Country

Source: https://www.eex.com/en/markets/power/power-futures