Border flow rights and contracts for differences of differences: Models for transmission property rights

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Outline

- Context and goals,
- Hedging of transmission and energy prices,
- Remunerating transmission investment,
- Drawbacks of financial transmission rights,
- Border flow rights,
- Example,
- Contracts for differences of differences,
- Entrepreneurial interconnectors.

Context and goals.

- Current Financial Transmission Rights (FTR) mechanisms in US require the Independent System Operator (ISO) to be the issuer of the transmission rights:
  - ISO performs both short-term dispatch of energy and is also involved in longer-term forward contracting for transmission,
  - ISO does not provide market for forward contracting of both transmission and energy simultaneously.

Context and goals.

- Goal 1: Define a new transmission property right that does not require the ISO to be the issuer of transmission rights:
  - "Border flow rights,"
  - Allows forward contracting of both energy and transmission simultaneously through a single exchange.

Context and goals.

- If there are transmission outages compared to the test system that the ISO uses for issuing transmission rights then the ISO faces a revenue shortfall,
- Goal 2: Remove the risk to the ISO of revenue shortfall under transmission outage conditions:
  - Devolve risk to transmission owner.

Context and goals.

- FTRs not only hedge transmission risk but have also been proposed as a property right to support entrepreneurial interconnectors,
- Goal 3: Define a new financial transmission right built on border flow rights that also supports entrepreneurial interconnectors:
  - "Contracts for differences of differences."

Hedging of transmission and energy prices.

- Locational marginal prices (LMP) provide efficient marginal incentives for energy production and consumption,
- LMP differences provide efficient marginal incentives for use of transmission services,
- Volatility of LMPs has prompted the creation of financial hedging instruments such as “contracts for differences” (CFDs) and “financial transmission rights” (FTRs).

Contracts for differences (CFDs).

- Pays the product of:
  - a contract quantity times
  - the difference between a strike price and the LMP,
- Allows co-located demand and generator to both costlessly hedge their exposure to LMP volatility at a single bus,
- Because of financial character, variations on the basic CFD concept can be flexibly defined without constraining dispatch.

Financial transmission rights (FTRs).

- Pays the product of:
  - a contract quantity times
  - the difference between nodal prices,
- Allows a transmission customer to hedge its exposure to the volatility of LMP differences between two busses,
- Together with CFD, an FTR allows non co-located demand and generator to both hedge their exposure to LMP volatility at their busses.

Financial transmission rights (FTRs).

- In current implementations:
  - the ISO receives congestion rental and
  - FTR holders are paid by the ISO,
- To ensure that congestion rental is adequate to cover FTR obligations, the issued FTRs must satisfy “simultaneous feasibility” for a test system:
  - ISO involved in both short-term dispatch of energy and also in forward contracting of longer-term transmission services.

Drawbacks of FTRs.

- To reconfigure FTRs for alternative needs of transmission customers:
  - requires centralized reconfiguration auction satisfying simultaneous feasibility test using test system,
- Simultaneous feasibility test imposes restrictions on flexibility of FTRs:
  - Financial instruments besides “obligation” “point-to-point” FTRs present difficulties for representation in the simultaneous feasibility test,
  - Particularly if AC power flow is modeled.

Drawbacks of FTRs.

- Compare FTR to flexibility of a generator selling energy at nodal prices:
  - Nodal price stream reflects (marginal) value of energy to system at each time and
  - Financial contracts such as CFDs and variations can be sold without centralized reconfiguration auction.

Current implementations of energy and transmission rights.

Asset:	Product:	Underlying revenue stream:	Financial instrument
Generation	Energy	Energy times LMP	Contracts for differences and variations
Transmission	Energy transport	???	Financial transmission right

Drawbacks of FTRs.

- ISO must issue the FTRs but is generally not involved in issuing CFDs so that there is no single forward financial market for both energy and transmission services,
- If lines are out of service compared to the test system, there may be revenue inadequacy for the ISO,
- Avoiding revenue inadequacy for the ISO requires a derating policy for FTRs that blunts the effectiveness of FTRs as hedging instruments.

Remunerating transmission investment.

- FTRs have been proposed as a property right for investors in transmission,
- Builder of line obtains right to capacity times a nodal price difference (Hogan; Bushnell and Stoft):
  - Investor nominates incremental financial transmission right (FTR) between two busses that is made possible by incremental investment,
  - Reward investor with capacity of right times nodal price difference between busses.

Remunerating transmission investment.

- Bushnell and Stoft (1996) showed that if the actual dispatch is the same as the operating point for the SFT then the incentive for building new transmission is efficient.
- Relies on, among other things, investor deciding carefully on nomination of incremental FTR:
  - Seasonality, changes in patterns of dispatch.

Drawbacks of FTRs as a property right.

- Because demand varies, it is unlikely that actual dispatch will match the operating point for the SFT:
  - value of the transmission might not accrue to the FTR holder.
- For example, if flow and prices reverse compared to assumed direction in FTR then nominated FTR has negative value, but transmission has contributed to welfare.

Drawbacks of FTRs as a property right.

- Nomination of FTR to maximize value to investor is problematic because of variation of patterns of flows compared to the operating point for the SFT.
- FTRs do not reflect the “underlying” value of the line to transmit under various conditions, only reflect the value under dispatches that are similar to the operating point of the SFT:
  - During other conditions, ISO accumulates surplus.

Drawbacks of FTRs as a property right.

- Builder of new line is awarded an FTR that reflects all of the increase in capability due to line:
  - at least for dispatch matching operating point of SFT,
- Consequently, other lines will experience increased flows without any remuneration.
- Other line owners have no incentive to maintain this capacity since the FTR does not benefit them.

Flowgate rights.

- Proposed by Chao and Peck (1996),
- Remunerates lines that have binding capacity constraints,
- Does not require central auction for reconfiguration,
- Again, other lines receive no remuneration and consequently have no incentive to maintain their capacity.

Border flow rights.

- Seek a remuneration scheme that is analogous to nodal price stream for energy:
  - Remuneration to transmission owner for providing transmission,
  - Not dependent on nomination of FTR,
- Seek a scheme that allows for sale of financial contracts without (necessarily) central reconfiguration by ISO.

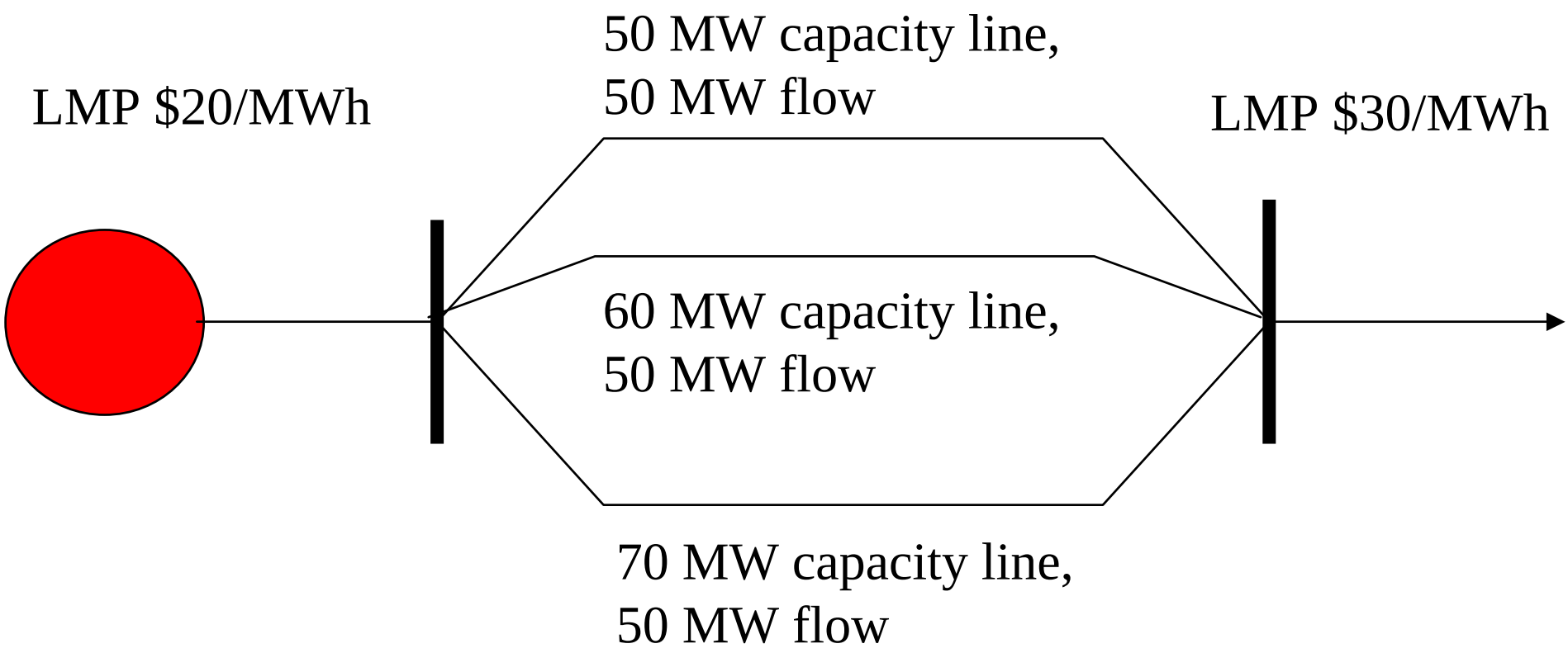
Border flow rights.

- Builds on work of Gribik *et al.* (2003, 2005)
- Remunerate transmission based on flows and LMPs:
  - Pay the line for energy it delivers to the rest of the system at the LMP,
  - Line pays for energy it takes from the rest of the system at the LMP,
- Re-apportions congestion rental directly to lines:
  - Guarantees revenue adequacy for ISO under all dispatch conditions.

Three parallel line example.

- Consider three parallel lines with capacities 50 MW, 60 MW, and 70 MW and equal admittances:
  - Ignore security constraints in example.

Border flow rights.



- Each line remunerated according to product of flow on line multiplied by nodal price difference between ends,
- Each line receives 50 MW times $(30 – 20)/MWh.

Contracts for differences of differences (CFDDs).

- Analogous to contracts for differences in energy, but is a contract to hedge deviations from strike price for differences in nodal prices,
- Pays the product of:
  - a contract quantity times
  - the difference between a strike price and the difference in LMPs between two nominated busses.

Contracts for differences of differences (CFDDs).

- Financial contract between transmission owner and transmission customer,
- Allows hedging of volatility in LMP differences.
- Financial transmission right that can be sold without central reconfiguration auction.
- A CFD and a CFDD allows non co-located demand and generator and the transmission joining them to hedge their exposure to LMP volatility at their busses.

Contracts for differences of differences (CFDDs).

- Can be flexibly defined without restriction of simultaneous feasibility test,
- ISO is revenue neutral under all dispatch conditions,
- No risk to ISO of revenue shortfall under outage condition:
  - risk is devolved to transmission owner who has more direct control of maintenance scheduling.

Proposed energy and transmission rights.

Asset:	Product:	Underlying revenue stream:	Financial instrument
Generation	Energy	Energy times LMP	Contracts for differences and variations
Transmission	Energy transport	Energy times LMP differences	Contracts for differences of differences

Entrepreneurial interconnectors.

- Incentives provided by border flow rights are same as the basis for sensitivity based transmission planning (Dechamps and Jamoulle, 1980):
  - Correct incentives for coalition funded marginal expansion of transmission in absence of lumpiness and economies of scale,
- Does not deal with lumpiness, economies of scale, and free rider issues.

Conclusion

- Incentives for efficient use and expansion of transmission,
- Nodal pricing to provide efficient incentives for use,
- Border flow rights as remuneration scheme for transmission together with contracts for differences of differences:
  - Alternative to FTR-based mechanism,
  - Defines payment reflecting value of transmission to system at each time,
  - Allows for decentralized or non-ISO exchange reconfiguration of financial transmission contracts.