The Gas Trap: Outcompeting Coal vs. Renewables

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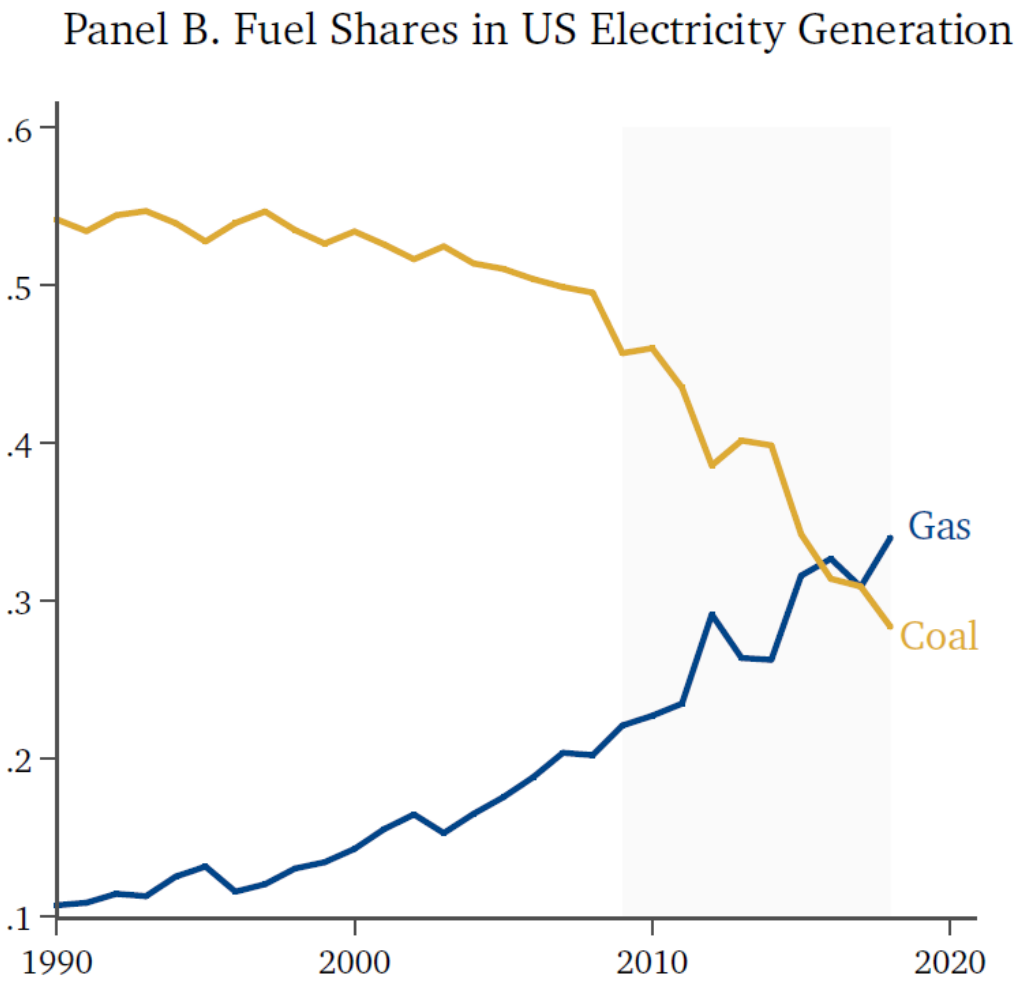
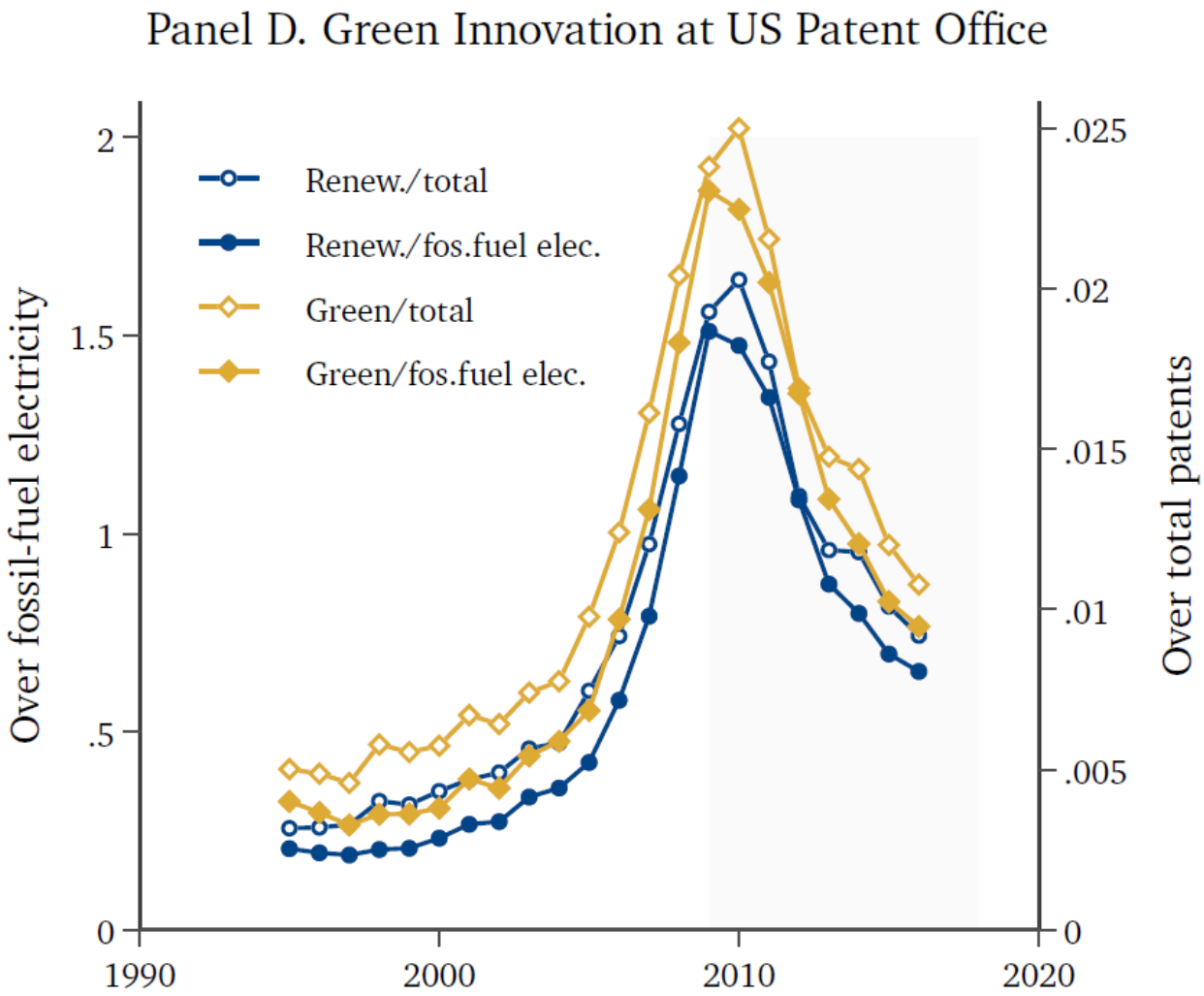
Outcompeting coal

More gas coincides with less coal (Acemoglu et al, 2023):



... or renewables

More gas also coincides with less renewables (Acemoglu et al, 2023):



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- Coal producers have strong incentives to free ride and abstain from taxing the fossil fuel content of its extraction.
  - What, then, **should** and **will** gas producers do?

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- *Note*: **the price elasticities vary with the time horizon**.

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  - Supply requires additional investments

A simple model

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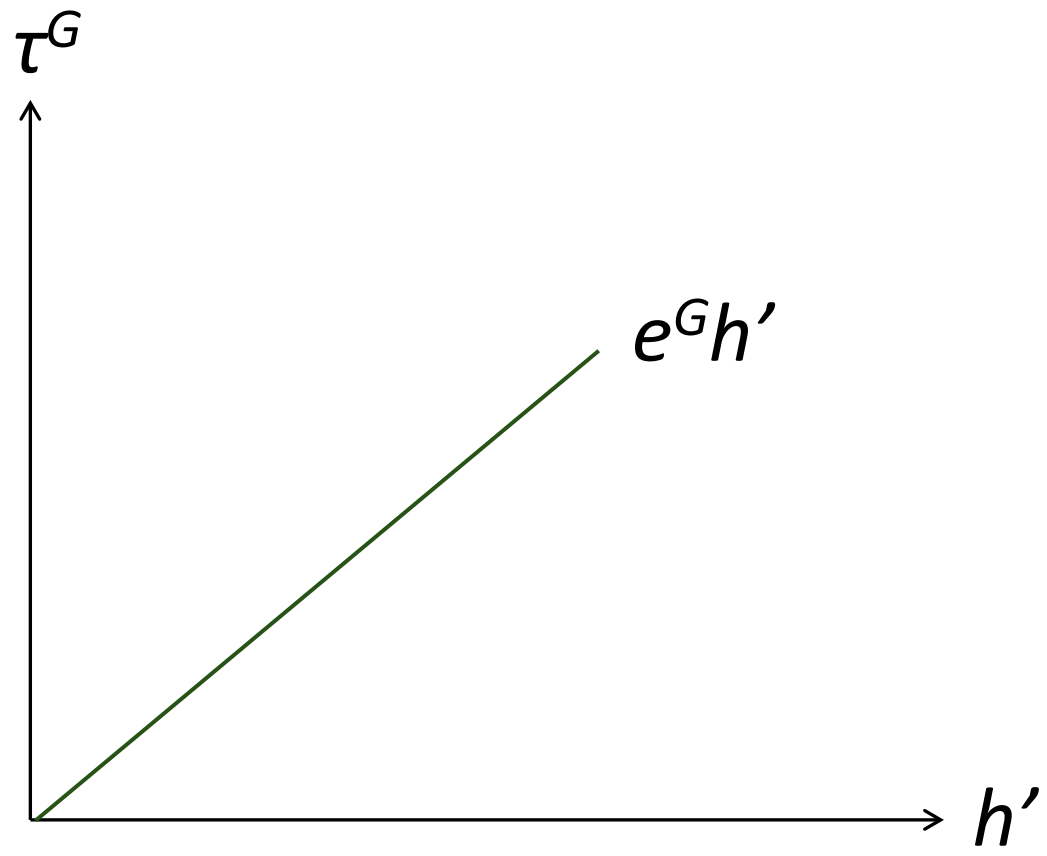
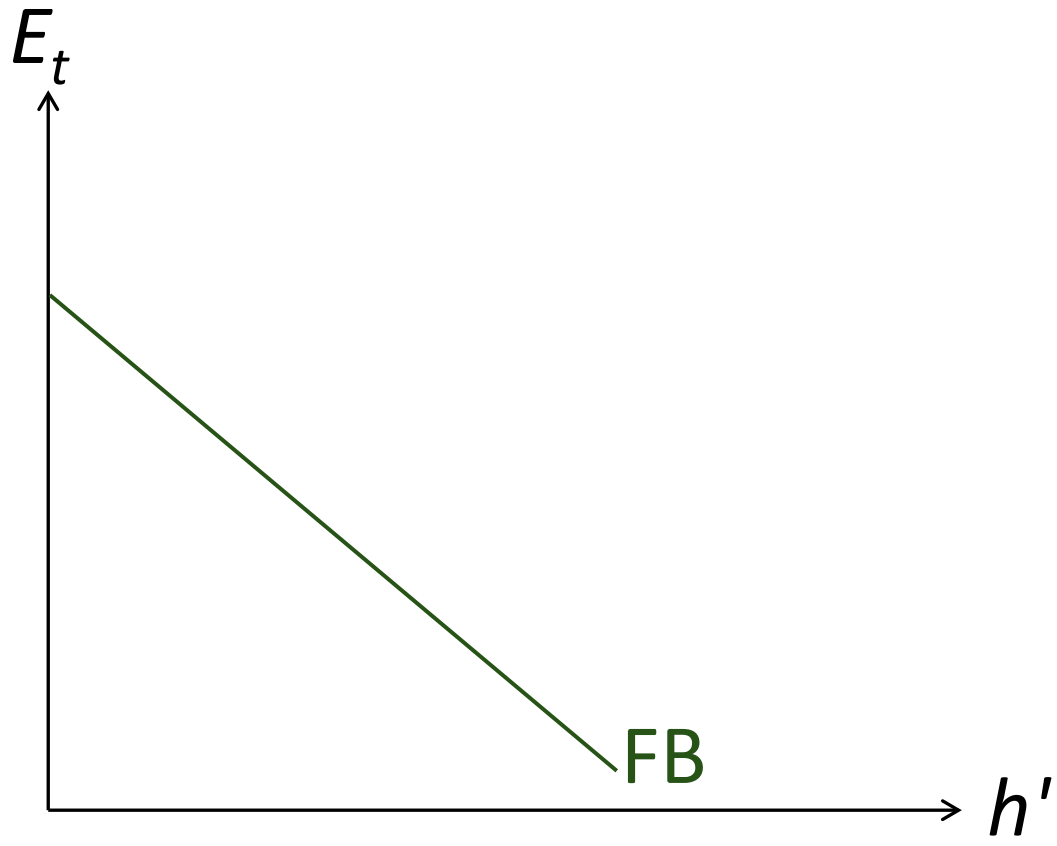
4. Gas is in-between, with carbon emission intensity $e^G \in \left(0, e^C\right)$.
5. Gas coalition M sets quotas or production tax τ^G to maximize:

$$p_t x_t^G - h\left(E_t\right), \text{ where } E_t = e^C x_t^C + e^G x_t^G.$$

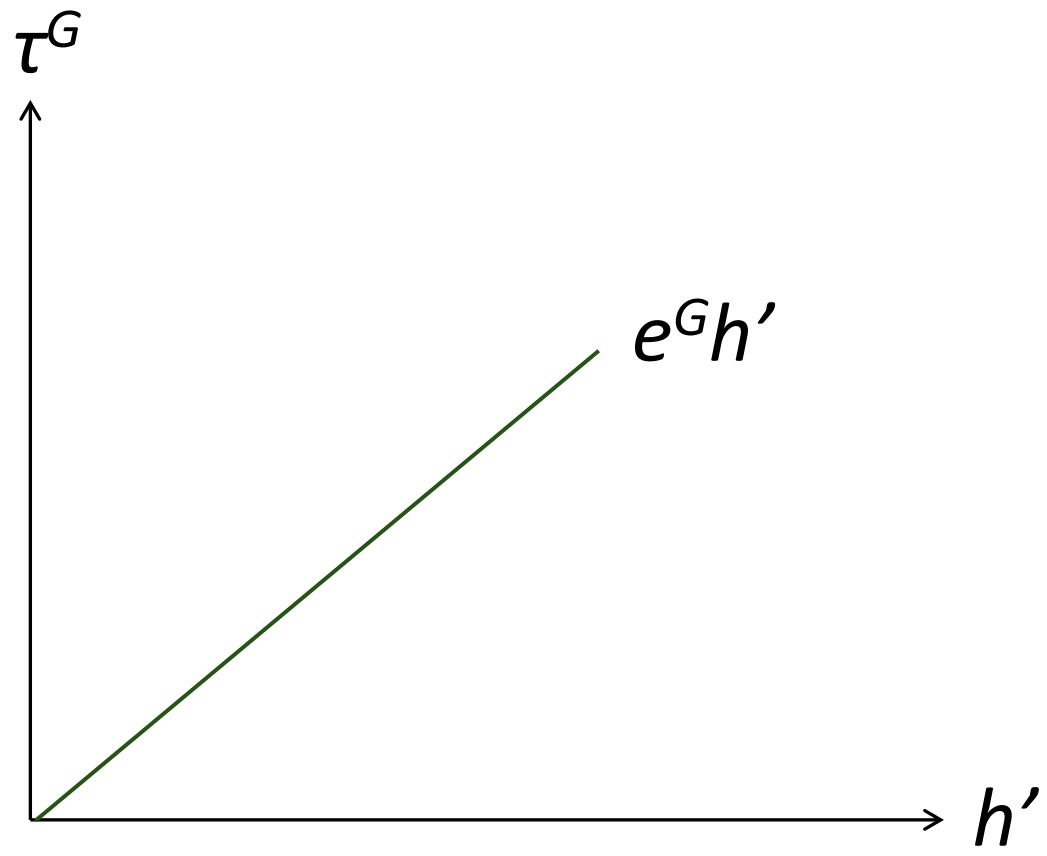
First Best

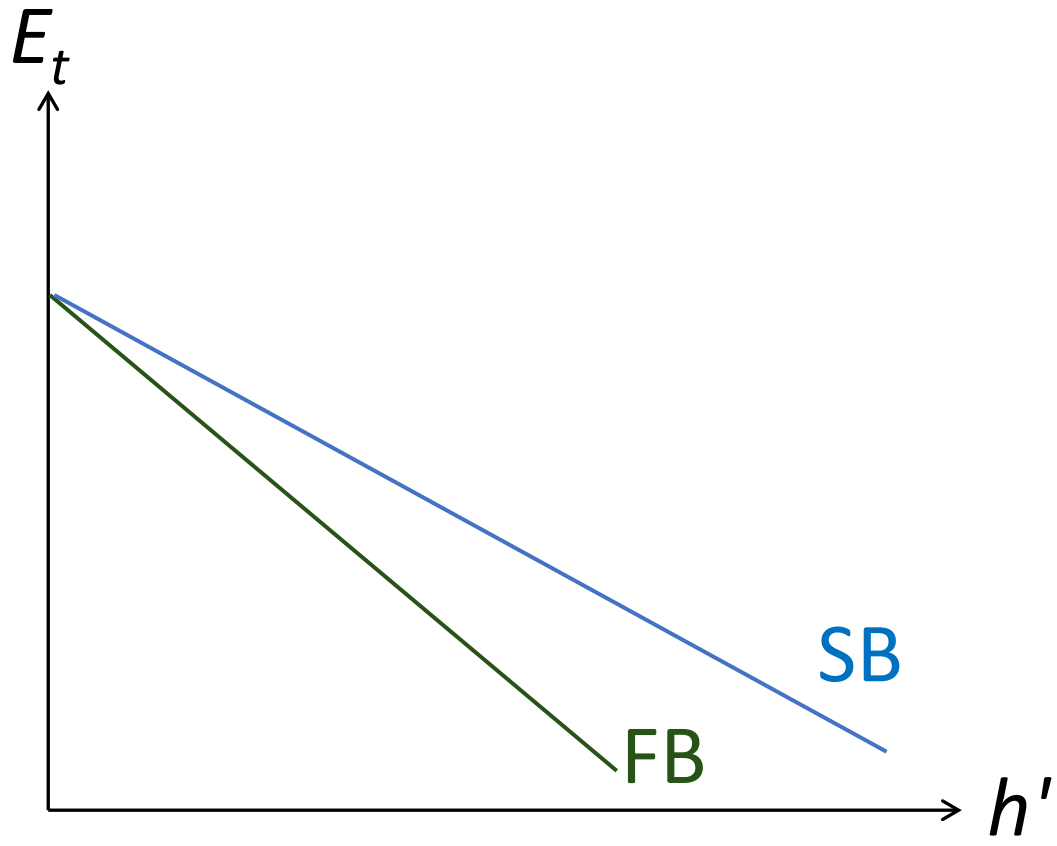




Proposition 0: First best is implemented by Pigou: $\tau^G = e^G h'$ and $\tau^C = e^C h'$.
The larger is h', the **larger** are τ^G and x^R and the **smaller** are x^G and E.

Second Best (Commitment)





Proposition 1: M prefers to commit to $\tau^G = e^G h'$, but $\tau^C = 0$.

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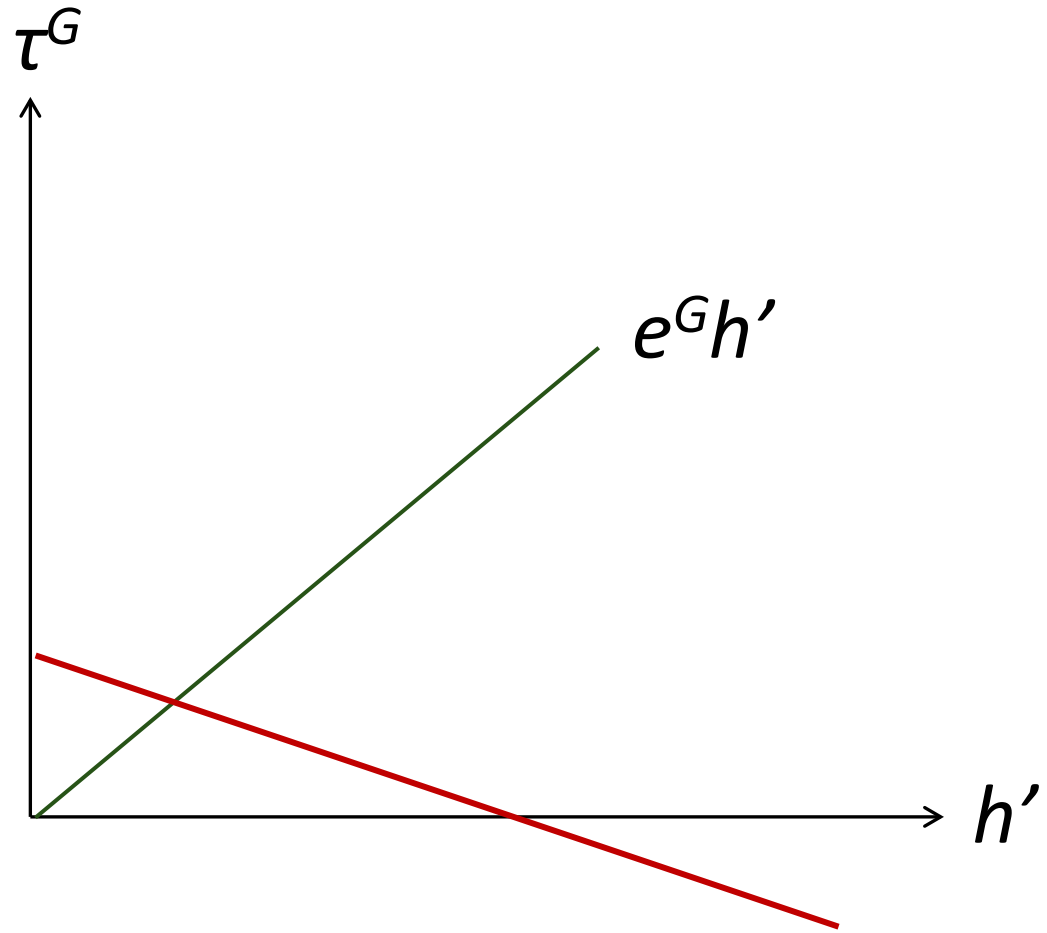
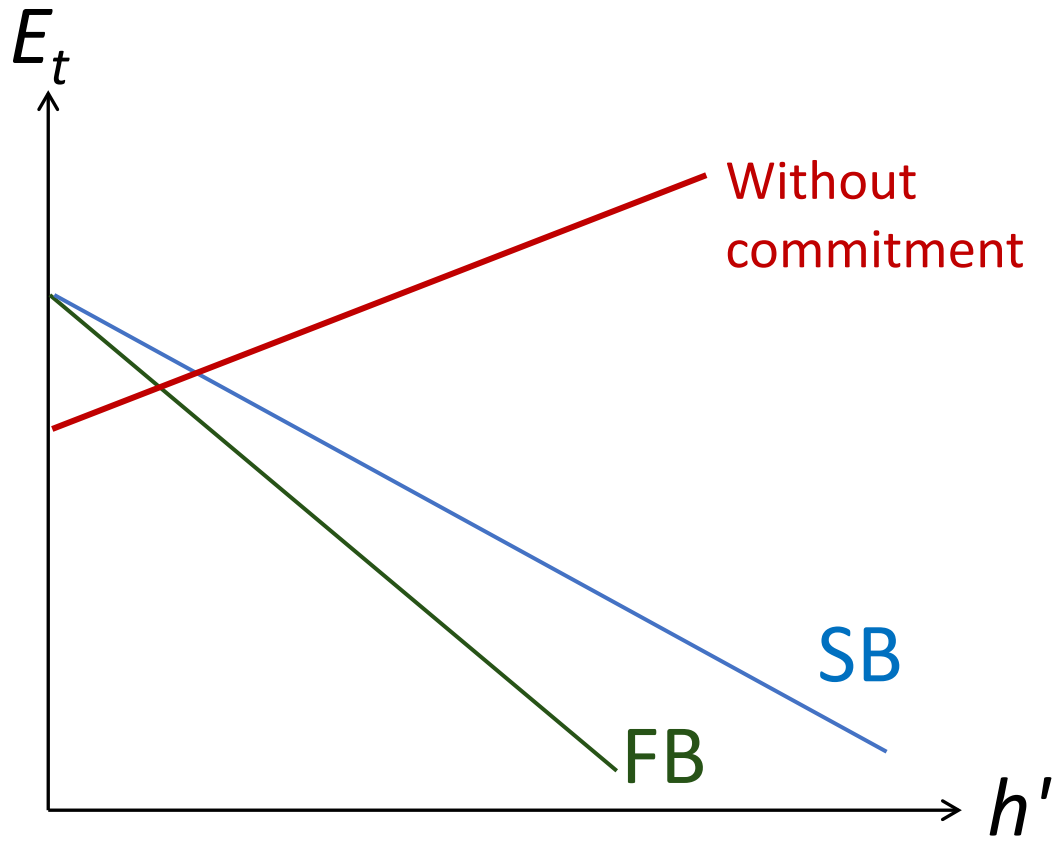
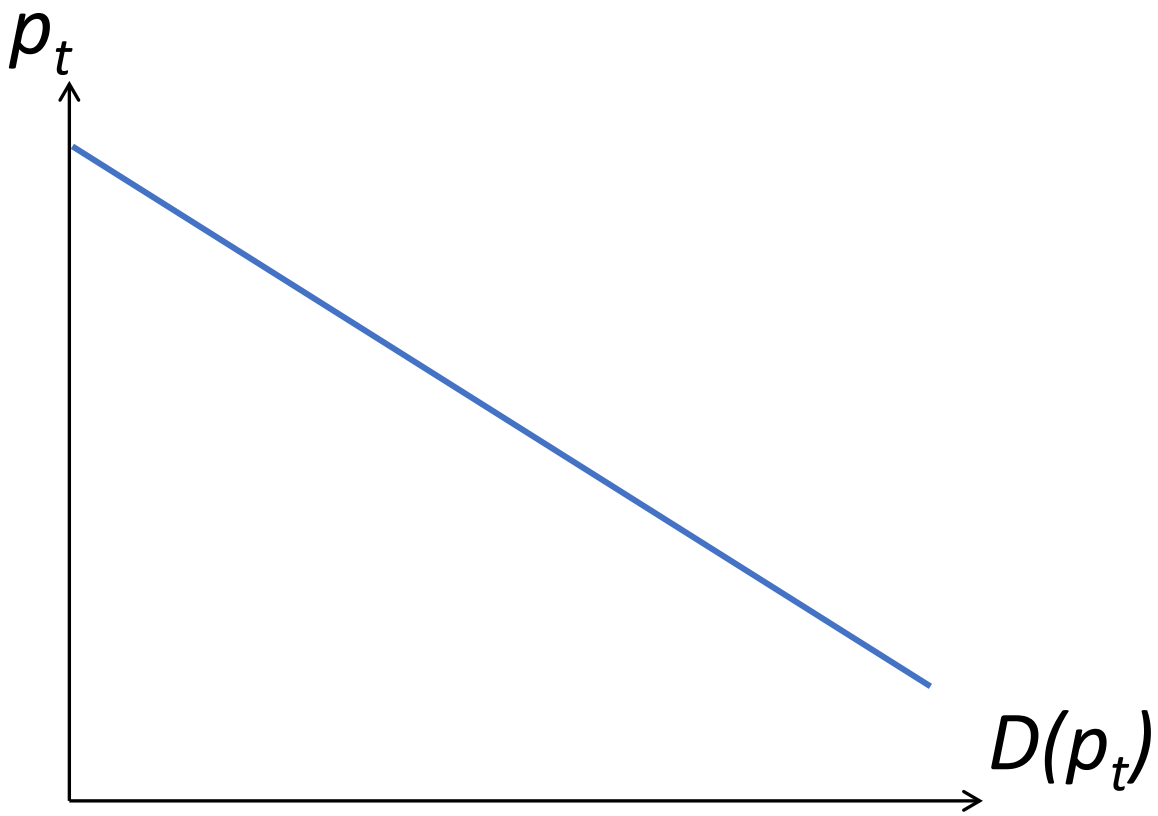
Equilibrium (without commitment)





Proposition 2: Suppose M cannot commit and $e^G/e^C < S'/(S'-D')$.
The larger is h', the **smaller** is τ^G and x^R and the **larger** are x^G and E.

Intuition



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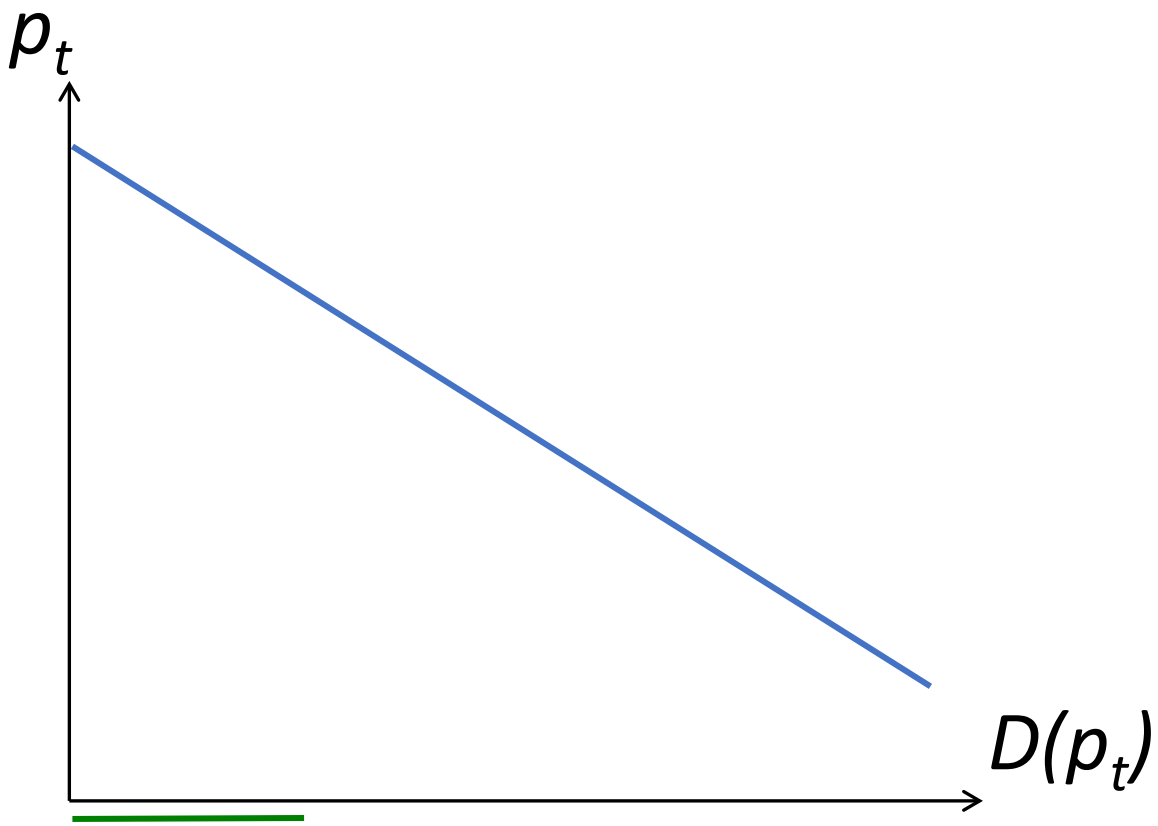

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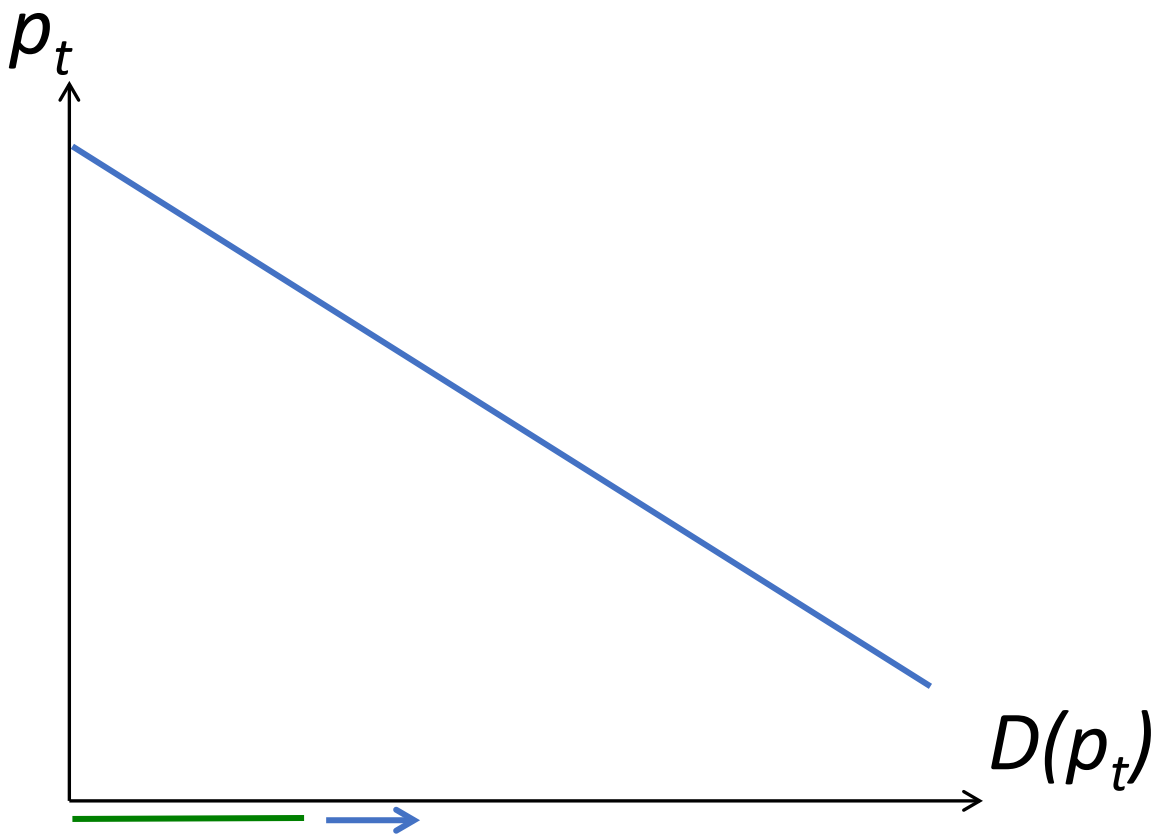

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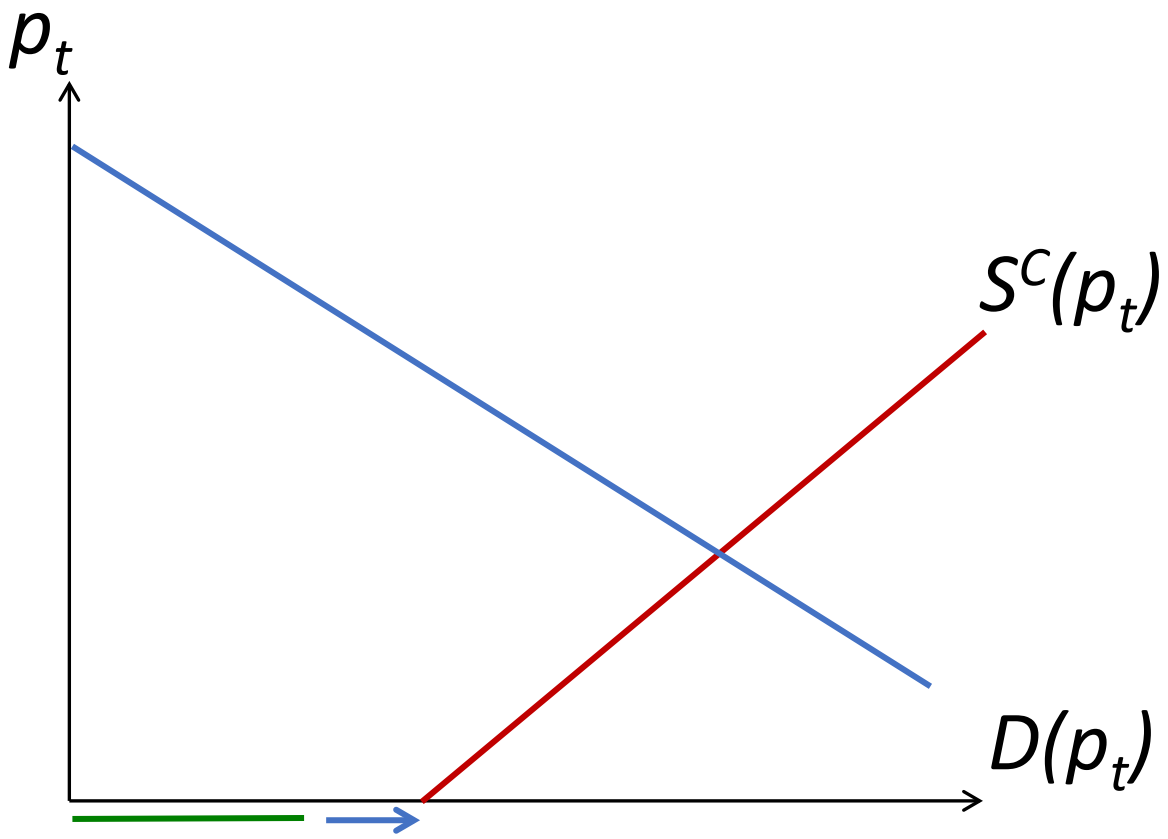

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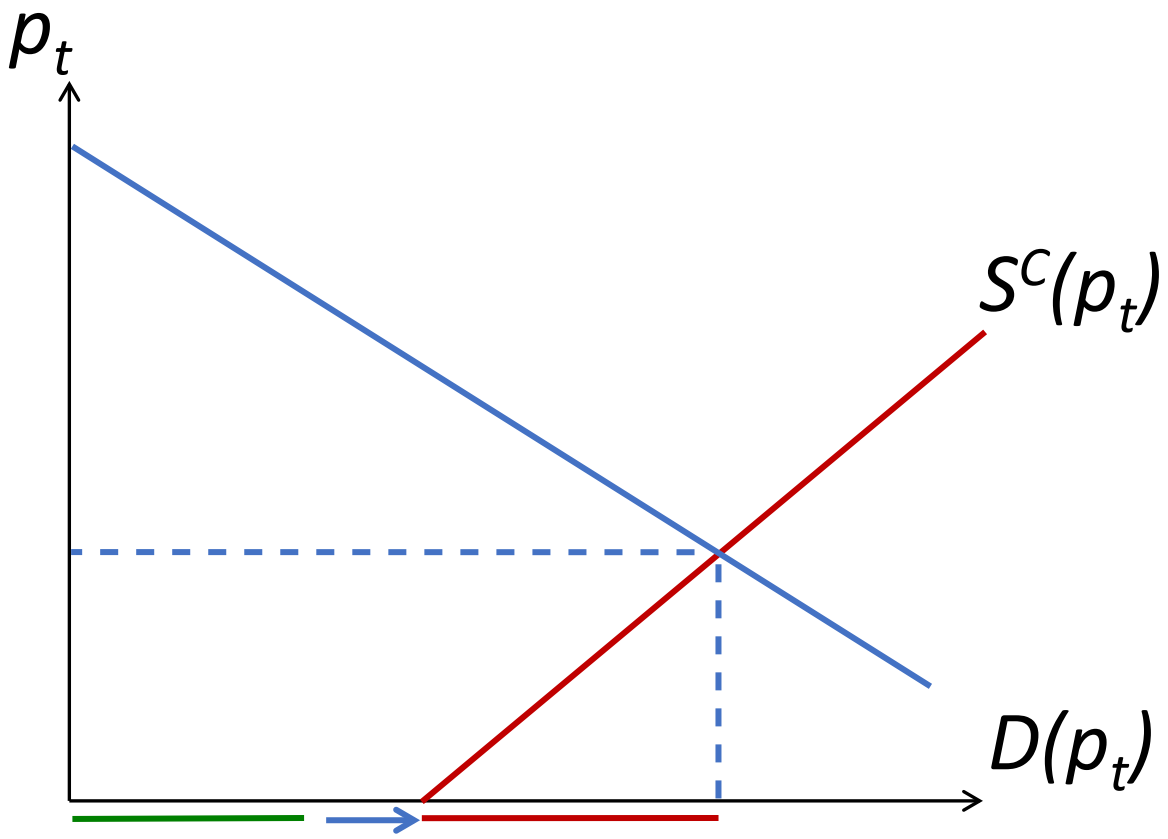

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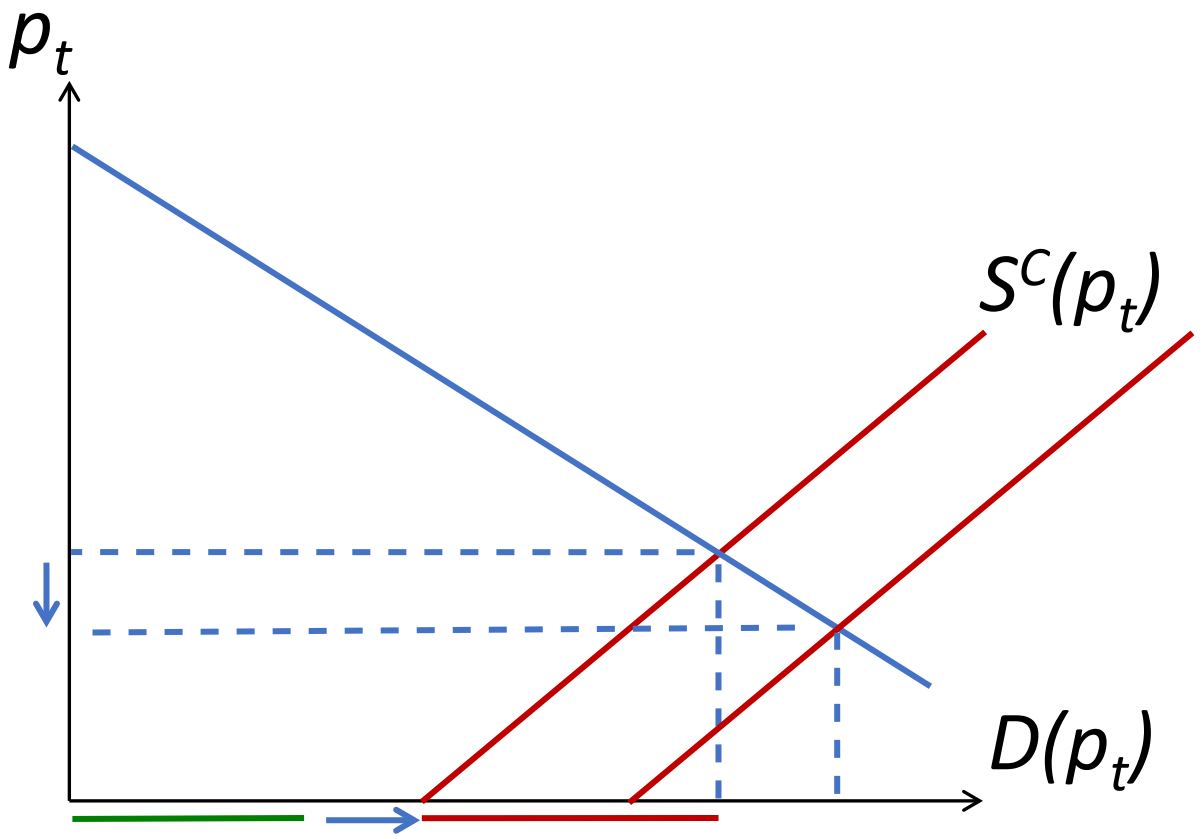

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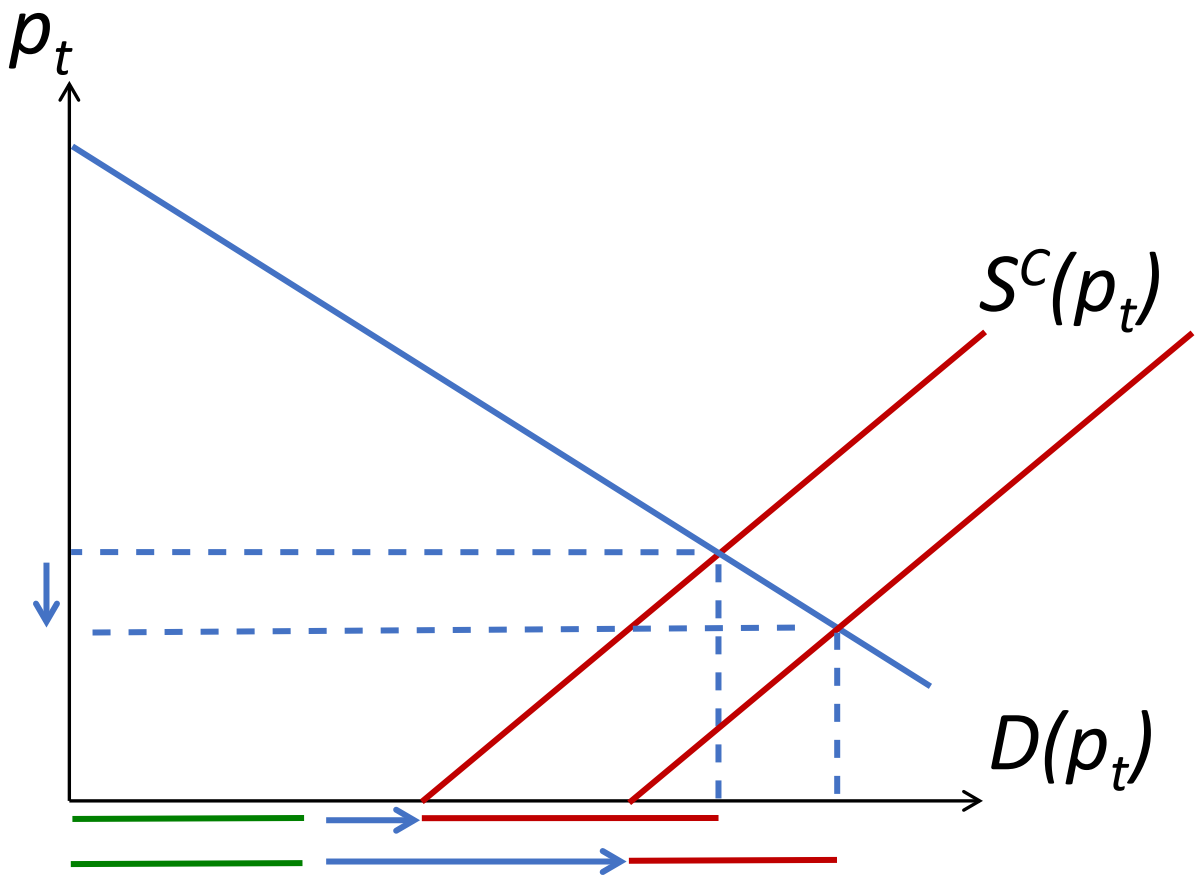

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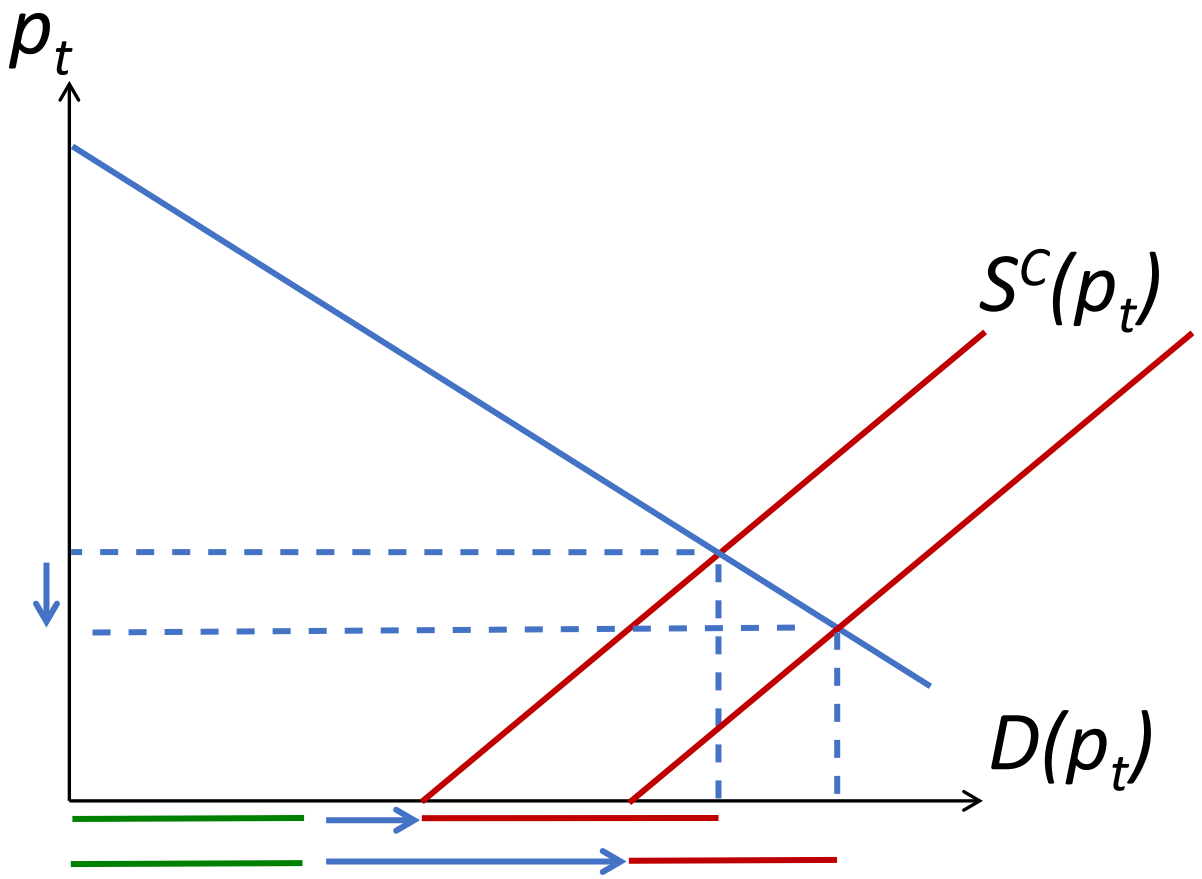

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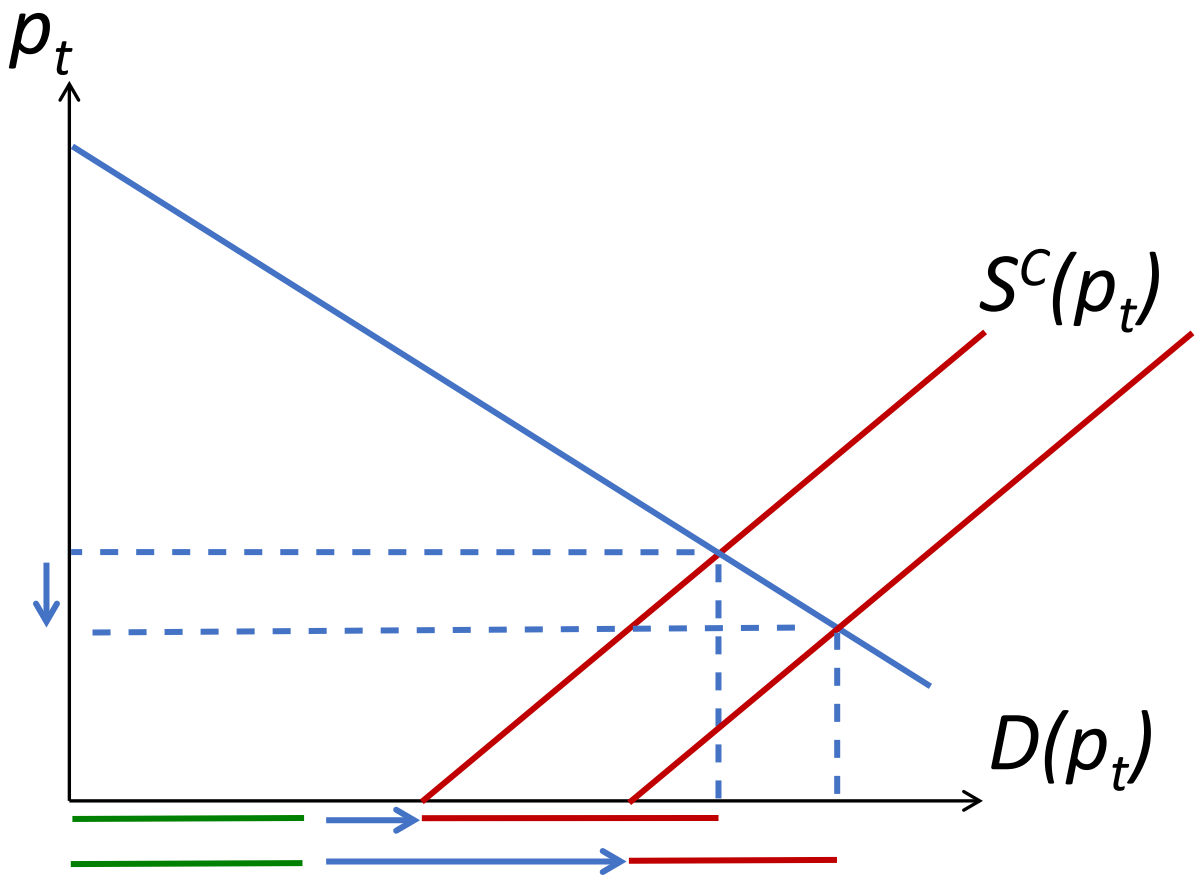

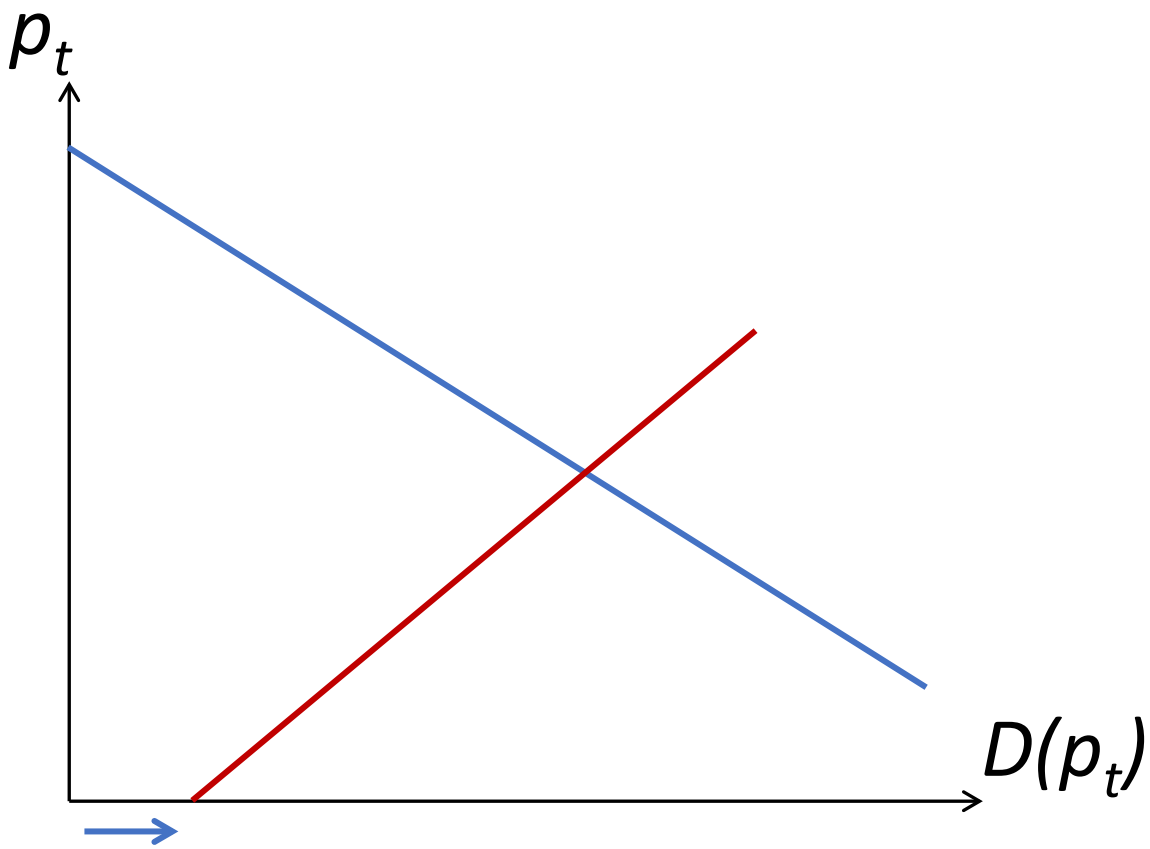

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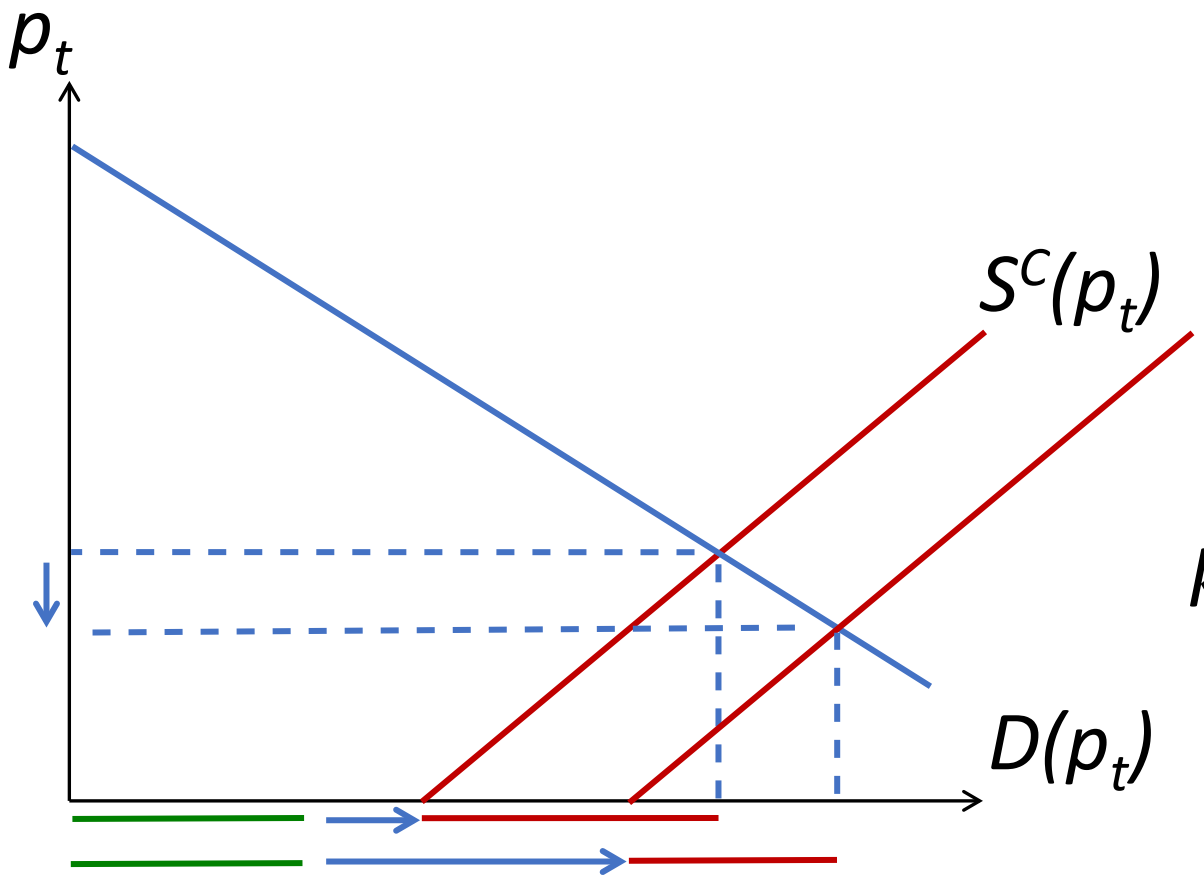

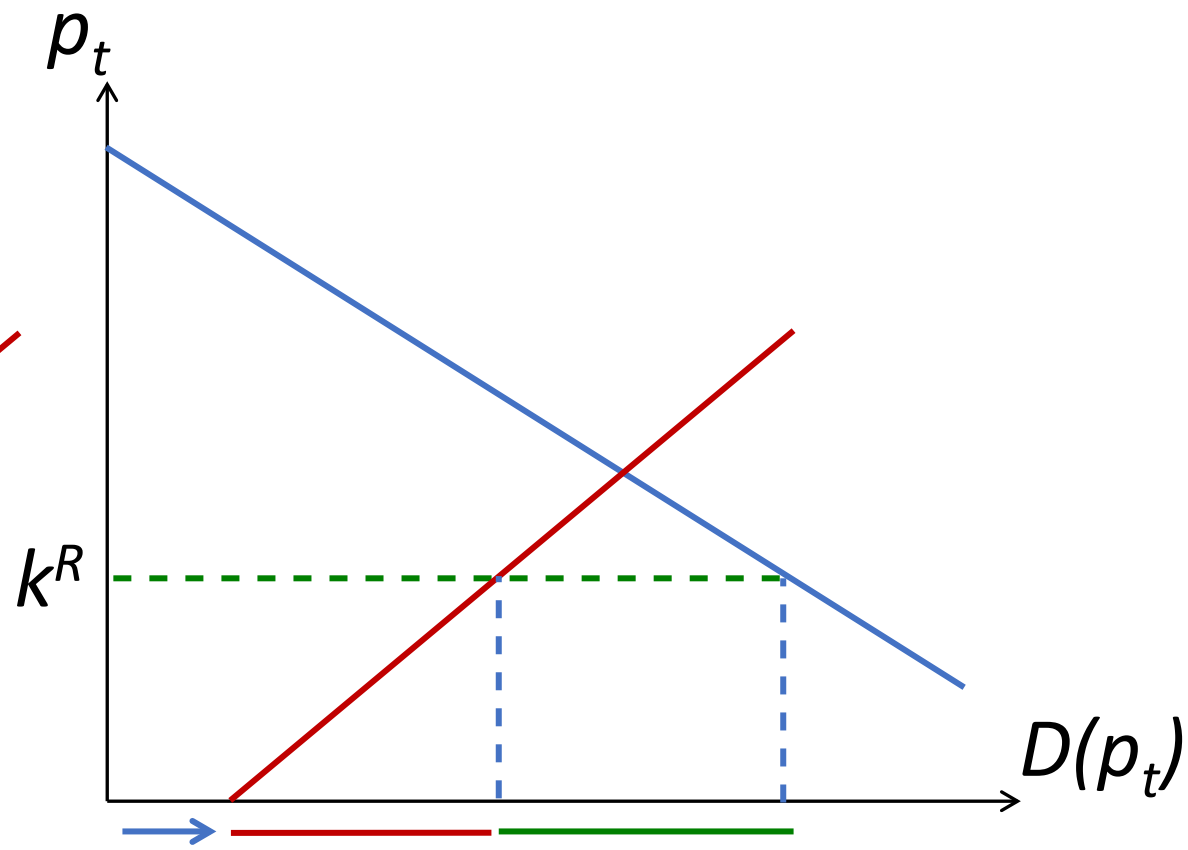

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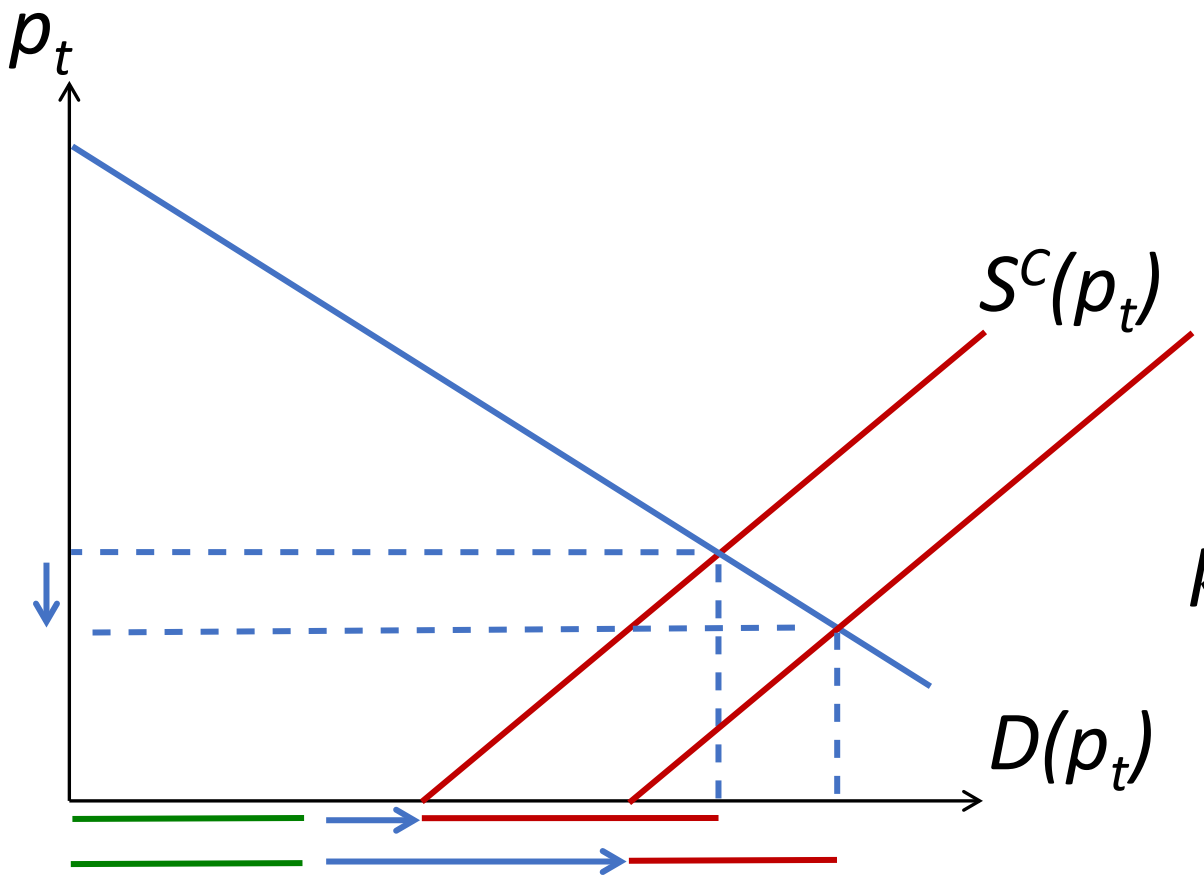

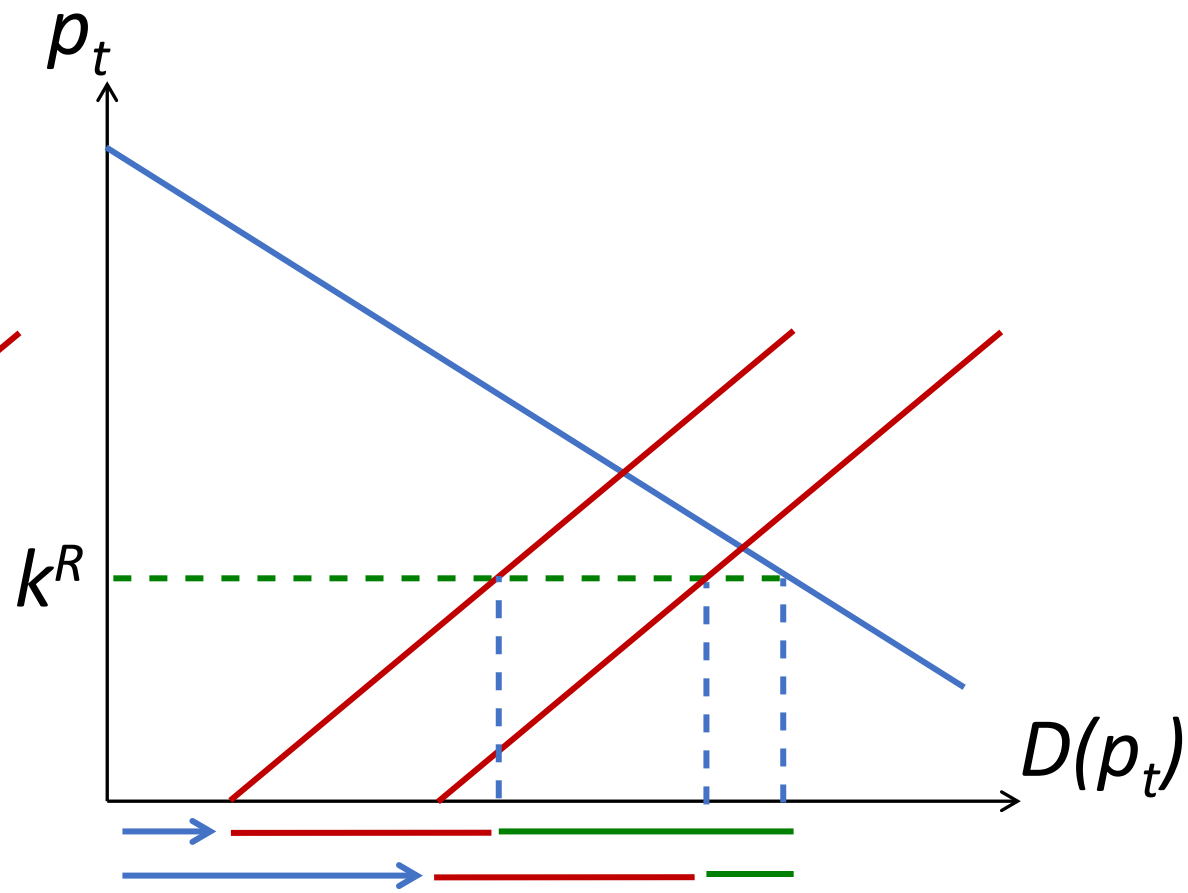

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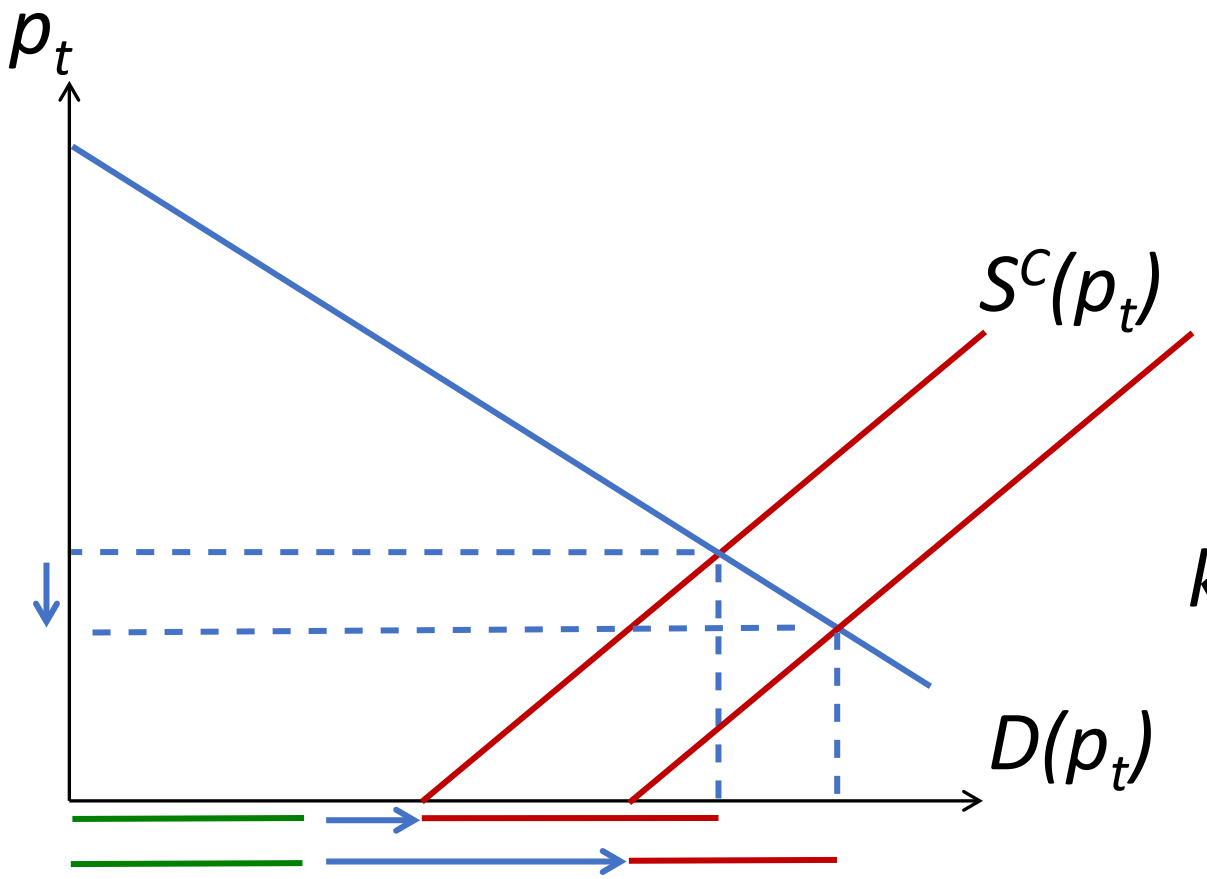

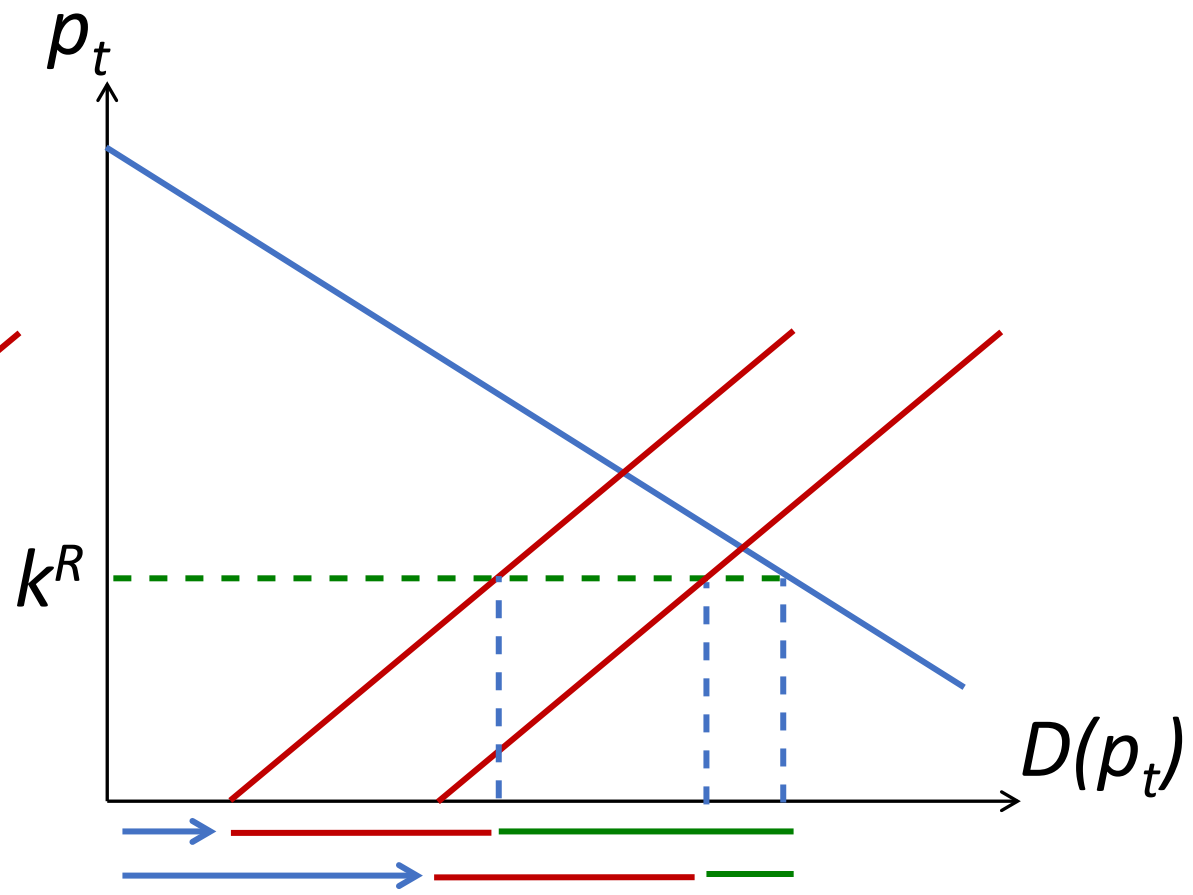

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Long term: More **gas** crowds out **renewables**, not **coal**.

Empirically relevant? For Europe?

Electricity sources	%	e^j	ε^j_{ST}	ε^j_{LT}
Coal	17.1	1.0	2.4	2.4
Gas – pipes	16.7	0.5	0.2	0.5
Gas – LNG	4.2	1.3	2.0	2.0
Oil	1.5	0.8	0.3	1.0
Renewables	34.8	0.0	0.0	3.0
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4. Noncommitment causes **18-43% more** gas and, thus, emission.

Generalizations strengthen the results

1. There can be non-cooperating gas producers and cooperating coal producers.
2. Countries and the coalition can produce multiple types of fuels, and emission contents can vary.
3. There can be many periods
4. Parameters can vary over time
5. With **learning by doing** in k^R, M would like to commit to lower x^G, but the non-commitment outcome is unchanged.
6. With **exhaustible resources**, M may deplete faster, as a commitment to reduce x^G_{t+1}.

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2. Search and exploration for new fields should be taxed.
3. A formal supply-side treaty may be necessary for credibility.

Policy Implications

Policy Implication 1: Tax search and exploration

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2. The second best is implemented with Pigou taxes on x^G_t, and zero taxes on s^G_t.

Policy Implication 1: Tax search and exploration

- The cost of x_{t+1}^G, $k_{t+1}^G\left(x_{t+1}^G, s_t^G\right)$, is influenced by search-and-exploration activity, s_t^G.

1. The first best is implemented with Pigou taxes on x_t^C and x_t^G, and zero taxes on s_t^G.
2. The second best is implemented with Pigou taxes on x_t^G, and zero taxes on s_t^G.
3. If M cannot commit, the equilibrium will be $\tau^G < e^G h'$. So, to partially commit to a smaller x_{t+1}^G, M will find it optimal to tax s_t^G:

$$\tau^S = \left(e^G h' - \tau^G\right) \frac{k_{12}^G}{k_{11}^G}$$

Policy Implication 2: Invest in Renewables

- Suppose M can invest in renewables before $t - \Delta^R$, so that $x_t^R = x_t^{M,R} + x_t^{\sim M,R}$.

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- With enough $x_t^{M,R}$, M will find it optimal with $\tau^G = aE_M H'$, even without commitment.
- This does not implement the second best if M's cost is larger than k^R.

Policy Implication 3: Supply-side agreements

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- An international agreement (/treaty) among multiple producers can help them to commit to future taxes.
- If this coalition also includes coal producers, the temptation to reduce the future price is limited.

The gas trap: Implications

- It is reasonable to consider $\Delta^C < \Delta^R$.
- Commit? $\tau^G \uparrow$, $x^R \uparrow$, $E \downarrow$ (Second best!)
- Cannot? $\tau^G \downarrow$, $x^R \downarrow$, $E \uparrow$ (Counterproductive!)

1. Direct investments in renewables helps to commit.
2. Search and exploration for new fields should be taxed.
3. A formal supply-side treaty may be necessary for credibility.