Austrian-Style Gasoline Price Regulation: How It May Backfire

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Motivation I/II

- High and volatile fuel prices: ongoing debates in public, media, politics
- Suspicious to antitrust authorities; abuse of market power?

$\Rightarrow$ **Regulatory price interventions** in several countries

- E.g. Austria, Luxembourg, Western Australia, Canada, Mexico
- **Direct** price regulations (LU, CA, MX) vs. regulation of **price variance** (AT, AU)

Motivation II/II

Austrian law (Since Jan. 2011)

Retail gasoline prices may only be increased once per day and simultaneously at noon, but may be decreased anytime.

- Virtually identical policies intensively discussed in Germany and New York State
- **Antitrust objective**:
  - Decrease consumer price uncertainty, hence...
  - ...make it easier for consumers to assess and evaluate prices, hence...
  - ...foster competition and increase consumer surplus in the market.

Key Idea to Model

- **Firm's scope of setting prices restricted** by policy
- Choosing low price at noon: **low margins** for rest of day
- May want to price high in beginning of cycle to maintain **pricing flexibility** later on

- But: **possible pro-competitive effect later in cycle** due to price ceilings and harsher competition
- Net effect on consumer surplus unclear $\rightarrow$ Model

Main Results: Policy Implications Under Different Setups

- Consumers' purchase period **exogenous**; **unit** demand:
  - Price distortions across periods; aggregate expected consumer surplus and firm profits unchanged
- Consumers' purchase period **endogenous**; **unit** demand:
  - Some consumers optimally wait for lower prices despite different preference
  - Firms profits unchanged no matter how many consumers wait
  - Total consumer surplus unambiguously reduced

Related Literature

- **Direct extension of Varian (1980)**'s model of price dispersion in homogeneous goods market
- Consumer search with **regulatory price ceilings**: Fershtman and Fishman (1994), Rauh (2004), Armstrong et al. (2009)

- **Austrian policy** (experimental and empirical): Haucap and Müller (2012), Berninghaus et al. (2012), Dewenter and Heimeshoff (2012)
- Intertemporal consumer search in gasoline markets (empirical): Noel (2012)

Model Setup

- **Firm duopoly**: $i = 1, 2$; **two periods**: $t = 1, 2$ (one price setting cycle)
- Price competition, homogeneous good, zero unit cost
- **Austrian policy.** In $t = 1$ (noon): may choose any price they want; in $t = 2$: cannot exceed first period price

- **Consumers**: unit demand up to valuation $v > 0$
- Fraction $\boldsymbol{\kappa} \in (0, 1)$ **purchases** in $\boldsymbol{t = 1}$, fraction $\boldsymbol{1 - \kappa}$ in $\boldsymbol{t = 2}$ (endogenized later)
- In each period, fraction $\boldsymbol{\lambda} \in (0, 1)$ of consumers **informed**; buy at cheapest firm. $\boldsymbol{1 - \lambda}$ **uninformed**; buy at random firm

Solution: SPNE

Equilibrium of the Second Stage

Suppose firms **chose prices p_1** and $p_2 < p_1$ in $t = 1$

Proposition

If $\frac{p_1}{p_2} < \frac{1+\lambda}{1-\lambda}$, in the unique equilibrium of the subgame, the firms keep charging their first period price with mass point $\alpha \in (0, 1)$ and randomize over the common price range $[\underline{p}, p_2]$ with probability $1 - \alpha$ according to the identical distribution $F(p)$. **Expected profits are $(1 - \kappa)\frac{1-\lambda}{2}p_1$** for each firm.

- Expected $t = 2$ firm profits are identical and proportional to **maximum** price chosen in $t = 1$
- **Firm incentive to soften price competition in $t = 1$**: harsh competition significantly hurts $t = 2$ profits

Equilibrium Actions of the First Stage

- Firms identical: Consider **symmetric equilibrium distributions** $G(p)$
- Standard undercutting arguments: **No mass points or holes; largest price in support v**. By first proposition:
- $\Pi_i^{tot}(v; G(p)) = \kappa\frac{1-\lambda}{2}v + (1-\kappa)\frac{1-\lambda}{2}v = \frac{1-\lambda}{2}v$

$$\mathbb{E}\Pi_i^{tot}(p; G(p)) = \quad G(p) \quad \left[\kappa\frac{1-\lambda}{2}p + (1-\kappa)\frac{1-\lambda}{2}p\right] +$$
$$(1-G(p)) \quad \left[\kappa\frac{1+\lambda}{2}p + (1-\kappa)\frac{1-\lambda}{2}\mathbb{E}_{\mathbb{G}}(\tilde{p}|\tilde{p} \geq p)\right]$$

Setting expressions equal and solving gives first period equilibrium distribution $G(p)$

Main Properties of Equilibrium I/II

First Period Prices

The more consumers purchase in $t = 1$, the lower the prices that are chosen in that period (in a probabilistic sense).

Intuition: More consumers in $t = 1 \rightarrow$ having high market share in $t = 2$ relatively less important $\rightarrow$ intensified competition in $t = 1$

Limit Results

As $\kappa \rightarrow 0$, $p_j = v$ in $t = 1$. As $\kappa \rightarrow 1$, firms price like in unregulated regime.

Hence, for any $\kappa < 1$, **first period consumers worse off** under regulation

Main Properties of Equilibrium II/II

Second Period Prices

Prices in the second period are probabilistically lower than without the regulation.

Hence, **second period consumers better off** under regulation

Countervailing Effects

Aggregate expected firm profits and consumer surplus unaffected by policy and invariant to changes in intertemporal consumer distribution κ.

Firms equilibrating strategies such that **expected profits constant irrespective of κ**

Example: First Period Equilibrium Price Distributions

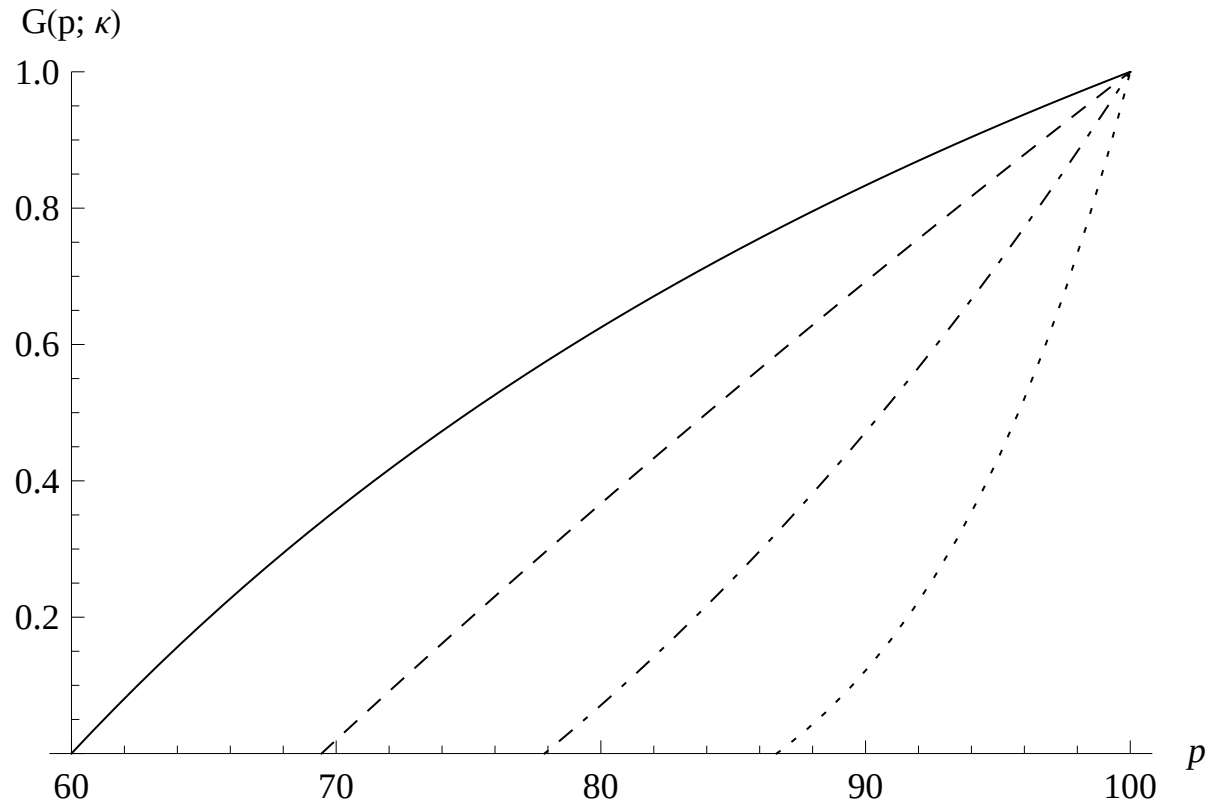


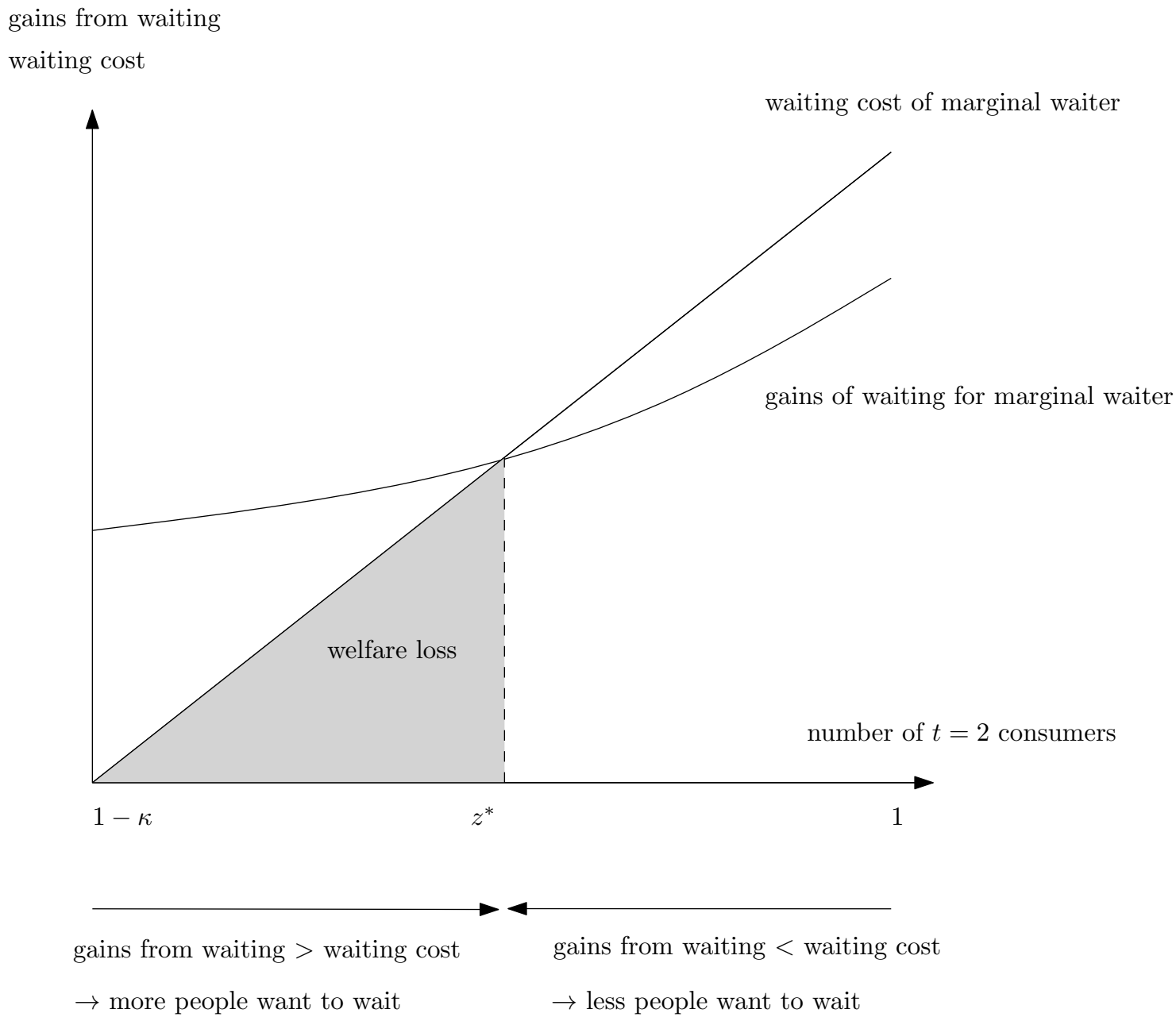
Figure : Equilibrium price distributions $F_0(p)$ (solid) and $G(p;\kappa)$ for $\kappa = 0.5$ (dashed), $\kappa = 0.25$ (dashed-dotted) and $\kappa = 0.1$ (dotted). $v = 100$, $\lambda = 0.25$.

Endogenizing Consumers' Purchase Period

- Exogenous intertemporal consumer distribution: Prices lower in $t = 2$, yet not everybody purchases then
- One justification: **Heterogeneous consumer preferences**
  - κ consumers prefer purchasing in $t = 1$, $1 - \kappa$ consumers in $t = 2$
  - κ consumers: have disutility of delaying purchase until $t = 2$ following some distribution

- All $1 - \kappa$ consumers purchase in $t = 2$: preference and lower prices
- $\boldsymbol{\kappa}$ **consumers face tradeoff**: compare individual gains from delaying purchase with cost of waiting
- Equilibrium: intertemporal consumer distribution such that nobody gains from waiting anymore

Illustration: Equilibrium Intertemporal Distribution



Welfare Loss Caused by the Policy

Proposition

The Austrian policy unambiguously leads to a decrease of consumer surplus and total social welfare. The total loss of welfare is given by the aggregate disutility incurred by purchase-delaying consumers.

Note: Aggregate welfare loss can be substantial. Example in paper: 7.3% of total CS

Intuition

- Firms' equilibrating strategies: Aggregate expected firm **profits independent** of **intertemporal consumer distribution**
- Due to **unit demand**: *Gross* gain of every waiting consumer must equal aggregate loss of all other consumers

- But: Optimally **switching consumers do not realize full gain of waiting**; part lost due to disutility!
- **Negative externality**: The fewer consumers purchase in $t = 1$, the less aggressive firm's pricing in **both** $t = 1$ and $t = 2$

Other Results

- **Paradox**: lower waiting cost for everybody can result in higher welfare loss
- Policy **harms inflexible / unknowing consumers**: critical threshold of waiting cost. Consumer with waiting cost $< W_{crit}$ benefit from policy, all others hurt
- If everybody delays purchase: everybody hurt except consumers with zero waiting cost

Summary

- Analysis of **real-world price regulation** in consumer-search framework
- Two-period duopoly model; **firms' pricing restricted** in second period according to **Austrian rule**
- If consumers' purchase time is exogenous, policy leads to price distortions that are welfare neutral on aggregate

- **If consumers' purchase time is endogenized, policy leads to unambiguously lower consumer surplus**
- **Model casts doubts on whether Austrian policy can effectively increase consumer surplus**